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General View of North Substation and Surroundings, Showing 66,000-Volt Tower Line in Right Background.

North Substation of Duquesne Light Company, Pittsburgh

Outdoor Substation in High-Voltage Loop Around Pittsburgh Proves Economical and Dependable—Used for Feeding 22,000-Volt Lines from 66,000-Volt Network and Sectionalizing Latter

NOTABLE among the electrical installations built for permanent service during the war is the North substation built and designed by the Duquesne Light Co., of Pittsburgh, Pa. This is an outdoor installation located in the open country a short distance north of Pittsburgh, in Ross township, Allegheny county, Pa. It forms part of a 66,000-volt transmission system which connects with substations now built and other substations to be built, all of which will form a loop around the city of Pittsburgh. This particular substation, during nearly two years of operation, has proved rugged, efficient and reliable. Its record in this regard shows that outdoor substations can be made an economical and dependable part of extensive central-station networks in suburban districts of large metropolitan cities.

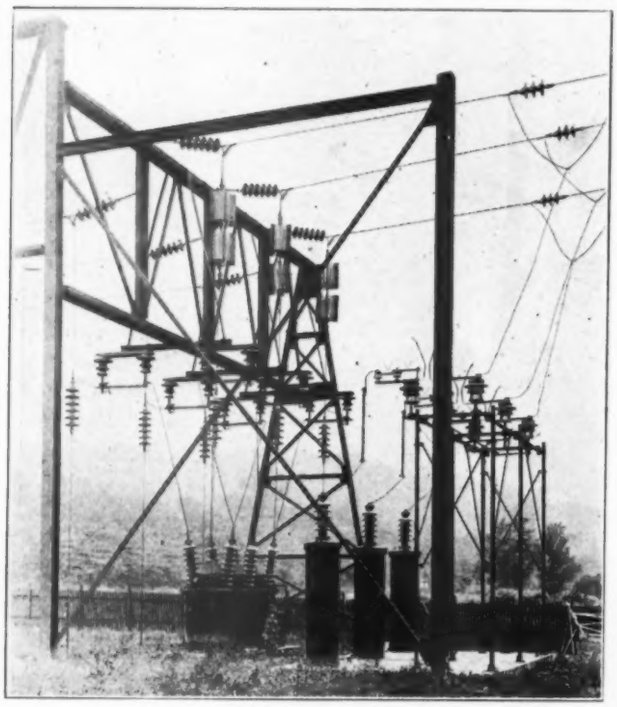
A fair idea of the topography of the district where North substation is located is gained from the two large illustrations herewith. The site was selected where at least the main part of it is fairly level and permits of easy installation of additional equipment in the future. In the initial installation provision is made for one 66,000-volt line, three main stepdown transformers and three 22,000-volt outgoing feeders. The plans provide for the ultimate installation of another 66,000-volt transmission line, three additional main transformers with a spare unit, and five other 22,000-volt feeders with necessary breakers and other auxiliaries. The complete layout, present and ultimate, is shown in the accompanying single-line diagram on which future additions are indicated by dotted lines.

Main line transformers of the self-cooled, radiator type are used. Each has a rated capacity of 4166 kv-a. and they are designed for a voltage of 66,000 on the primary side and 22,000 or 11,000 on the secondary. The secondary winding is so designed that voltages of 22,000 and 11,000 can, if desired, be supplied simultaneously. Under these conditions the transformer can give a rating of one-third normal kilovolt-amperes at 11,000 volts and two-thirds normal kilovolt-amperes at 22,000 volts.

Numerous difficulties were met in hauling the first of the three big transformers to the site from Millvale, where they had been brought by railroad. With the special haulage truck these units each weighed nearly 28 tons. Twelve heavy draft horses and the company's big electric truck had quite a task negotiating the hilly roads between Millvale and the substation site, the load lurching away from control on several occasions and sinking deep into the roadway. By means of block and tackle and the motor-driven winch on the electric truck the load was finally moved from the stalled places. Profiting from the experience gained in moving the first unit, the two others were moved without mishap.

Oil circuit-breakers of the electrically operated automatic overload type are used for the control of the power on both the 66,000 and 22,000-volt sides.

Those on the primary side are of the GA type and are mounted directly on the concrete foundations. One is used as a main-line breaker, while two others are used selectively in cutting the transformers in or out. On the secondary side, there is a breaker of the GB type



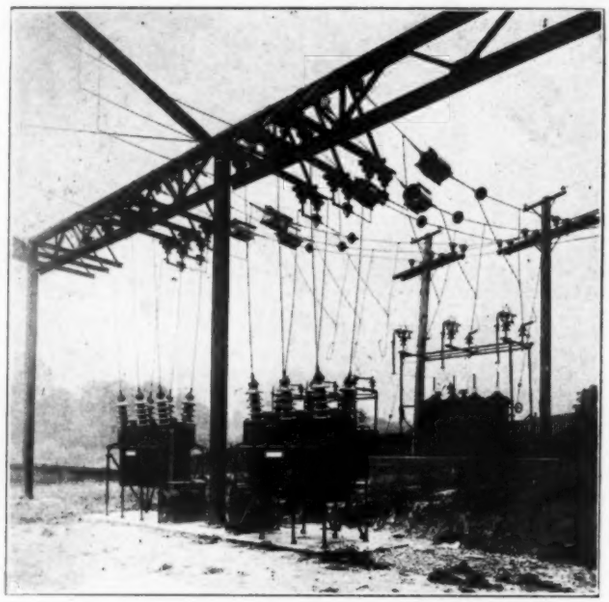
The 66,000-Volt Incoming Line With Kickoffs, Lightning Arresters, Choke Coils, Circuit-Breakers and Disconnects.

on each of the three 22,000-volt feeders, the breakers being mounted on pipe framework resting on the concrete foundation.

The substation, in addition to its transforming and distribution functions, serves as a lightning-arrester and sectionalizing station on the 66,000-volt line, the station being so connected to the line that a section of the latter forms a 66,000-volt station bus. By means of switching equipment located at each end of the bus, either the eastern or western section of the line may be disconnected from the station and the other section. One section of the high-voltage tower line comes from the company's Brunots Island generating station and the other section runs on to Cheswick.

Five sets of electrolytic lightning arresters are used, with auxiliary horn gaps, choke coils and disconnecting switches. Two sets are connected with the 66,000-volt line, one being at the east end of the 66,000-volt bus and connected with the line section at that end, and the other correspondingly located and connected at the west end. The other three electrolytic arrester sets are connected to the 22,000-volt outgoing feeders. For each set of electrolytic arresters there is an auxiliary set of horn-gap arresters, choke coils, disconnects, etc.

Steel framing is used throughout for the support



Control and Protective Apparatus for the 22,000-Volt Outgoing Lines.

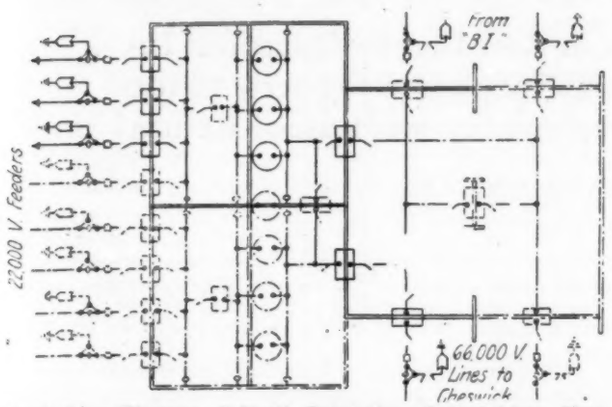
of all overhead apparatus, ample provision having been made for anchorage and bracing. Concrete foundations are provided for the legs and main columns of the framework and for the support of all transformers, circuit-breakers and lightning arresters.

Immediately adjoining the outdoor equipment is an attractively designed small brick building for housing

Another (Nearer) General View of North Substation, Showing Initial Installation of Three of the Big Transformers and Substation Building at Right.

of the office, meters and such other accessories and equipment as must be kept indoors. A battery-operated system is installed whereby the outdoor circuit-breakers are remote-controlled.

The transformers, oil circuit-breakers and electrolytic lightning arresters were furnished by the Westinghouse Electric & Manufacturing Co. Horn-gap arresters and certain other parts of the equipment were supplied by the Railway & Industrial Engineering Co.



Single-Line Diagram of North Substation—Dotted Lines Show Future Extensions.

THE BRITISH LAMP AND FIXTURE SITUATION.

The Illuminating Engineering Society of England at its first meeting for the season held in London on Nov. 25 had a demonstration of Pointolite lamps by P. Freedman, of the Ediswan laboratory, and an exhibition of a new form of illumination photometer by Haydn T. Harrison. The Sheringham daylight lamp was exhibited by L. C. Martin. This lamp or lamp attachment makes use of a colored reflector for correcting the distribution of energy in the spectrum of the artificial source. It was originally founded on the invention of G. Sheringham, a well-known artist who used simple colored reflectors or shades with artificial sources and found the quality of the light for painting greatly improved. The possibilities of the system have been to some extent worked out by Mr. Martin, the requisite distribution of colors being calculated on spectrophotometric measurements on opaque pigments made by means of Abney's color-patch apparatus. It is necessary in general to make use of arrangements to reflect the whole of the light from the colored surface, thus producing a type of indirect lighting unit which should have great possibilities in connection with shop-window lighting and many other commercial industrial uses.

A report was submitted to the meeting by the Committee on Progress in Lamps and Fixture Appliances, reviewing the present position of the metal-filament lamp and fittings (fixture) industry. The supply of lamps was shown to be rapidly improving after war-time difficulties and the production was now approximately equal to the consumption but it had not been possible to accumulate stocks in addition to meeting the demand. This may be possible within six months. It is anticipated that in the near future the whole of the British lamp manufacturers' requirements of glass bulbs will be met by home production, largely due to the adoption of automatic machinery for making bulbs and tubing. There are adequate supplies of drawn tungsten wire for filaments. During the war it was practically impossible to obtain argon (for the manufacture of lower wattages of gas-filled lamps) in England, but this difficulty has been overcome and adequate supplies are available.

When the new scheme of house building comes into operation the demand for metal-filament lamps will greatly increase.

The situation with reference to the supply of fittings scientifically designed has not been satisfactory, especially fittings for use in conjunction with gas-filled lamps. The manufacturers have lately been able to get to work designing and producing lanterns suitable for use with such lamps but shortage of the necessary globes was one of the chief difficulties. The committee expressed regret that there is not a supply of scientific fittings or reflectors for the smaller sizes of gas-filled lamps particularly for shop lighting. In several of the foregoing cases, it will be observed, the underproduction of glassware in England has militated against rapid progress.

WEST VIRGINIA POWER CO. TO MAKE CONSIDERABLE PLANT EXTENSIONS.

In connection with extensive construction work to be inaugurated by the Kentucky & West Virginia Power Co., 30 Church street, New York, plans are being prepared for the erection of large electric power stations at Logan, Sprigg, W. Va., and Pikeville, Ky. The work in the Logan district will, it is estimated, cost approximately $2,500,000 to extend over a period of two years, at which time the plant will have a generating capacity of 78,000 kw. The plans include extensions in the turbine room to allow for the installation of two 15,000 kw. capacity turbines with condensing equipment; the construction of a large boiler plant, etc., construction of a new 88,000-volt transmission line covering about 75 miles; as well as extensions in its 44,000- and 33,000-volt distributing systems covering about 100 miles, the 88,000-volt line to be used for tying in with the plants at Sprigg, Hazard, etc. A new 3,000-kw. turbine and surface condenser will be installed at the Sprigg plant, and plans have been prepared for the erection of a new addition to the outdoor transformer station. At Pikeville, it is proposed to install a new 10,000 kv-a. step-down transformer station, plans for which are now in process of formation. R. E. Breed, 30 Church street, New York, is president; Francis R. Weller, Hibbs building, Washington, D. C., is consulting engineer for the company in charge of the work.

LONG TRANSMISSION LINE UNDER CONSTRUCTION IN CANADA.

A transmission line from Winnipeg to Portage la Prairie is under construction at the present time. This line will be 60 miles long, will use steel towers and will have an ultimate capacity of 20,000 kw. The immediate installation is of one circuit of No. 0 aluminum cable which is estimated to carry 5000 kw. at 66,000 volts with a 3% drop in voltage at Portage la Prairie, or 10,000 kw. with 15% voltage loss. The second circuit will be installed as soon as the demand for power warrants it. The estimated cost is $4600 per mile, which includes substations at Winnipeg and Portage la Prairie. As it follows the highway, no right-of-way was purchased except at a few points where the line is on private property.

Central-Station Rates in Theory and Practice

Concluding Article—Appraisal in Rate Cases—Questions Involving Valuation of Physical and Intangible Property of the Utility—Operating Expenses, Depreciation and Rate of Return

By H. E. EISENMENGER

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This is the twenty-fifth and last article of this series which began in the issue of July 12. The series has consisted of six main parts as follows: Part I—The Cost of Electric Service; Part II—The Price of Electric Service; Part III—Systems of Charging; Part IV—Rate Analysis; Part V—Accuracy of Rates; Part VI—Public Utilities and Public Regulation. There were also sixteen inserts of supplementary matter.

These articles have attracted so much favorable attention on the part of companies, individuals and commissions interested in electric light and power rates that it has been decided to republish them in book form in the near future. Detailed announcement of the book will be made in an early issue.

PART VI—PUBLIC UTILITIES AND PUBLIC REGULATION—Continued.

CONTRIBUTED BY S. F. WALKER,
Formerly Associate Editor of Rate Research.

III. PROCEDURE IN RATE CASES—CONTINUED.

INVENTORY OF THE PHYSICAL PROPERTY OF THE UTILITY.

THE first step in making an appraisal is to make a complete inventory of the physical property. In this connection a number of matters may come up for decision in determining what property to include.

Donated Property.—Often a certain part of the properties used and useful to the furnishing of the service has been donated. For example, land has been donated to induce street railways and railroads to furnish service over a certain route. The question of whether or not donated property should be included in an appraisal for rate making has been variously decided, but the rule has been, unless there are certain modifying circumstances, to include all properties however acquired that are now used and useful to the furnishing of utility service.

Service Paid For by Consumers.—When public utility companies were first established it was customary to require consumers to furnish their own service connections. Where this has been done, commissions in making valuations have sometimes held that the value of such services should not be included, that the customer having paid for the property should not be made to pay a return to the company on the value of that property. But usually the customers who furnished the property will not be the ones affected by the rates to be established in the case. The records do not always show just what services were furnished by the customer and what by the company. The commissions have usually included this property, holding that the ownership is in the company the same as in the case of gifts and the manner of its acquisition, having belonged to a period prior to regulation, is one with which the commissions are not concerned.

Discarded Property.—Discarded property, such as may be found in any utility system due to construction of a larger property than later developments in the community justified, or more often due to the consolidation of competing properties, is another matter for consideration. It has generally been conceded that such discarded property must be included until provision can be made for its gradual amortization in cases where the investment in such property has been made in good faith and with a reasonable exercise of judgment to best serve the interests of the community.

In one case where the property under investigation was the result of consolidation of a number of competing companies the Pennsylvania Public Service Commission refused to allow the value of parallel lines and duplicate equipment in the rate base, but in reviewing the Commission's decision the Supreme Court pointed out that such holding was not in public interest. The court said:

"If the utility companies in organizing into one operating plant a number of smaller ones must be deprived of a fair return on the value of the properties purchased and are also limited to the reduced cost of operation by reason of such consolidation, it is evident that the more practical way should be to permit the companies to remain separate operating concerns.

"The public is entitled to a fair benefit from every such move made by a utility concern and where they assemble a number of plants with separate overhead and operating charges into one plant with one overhead charge and one or more operating plants, while the operating plant of some of the separate units may be rendered useless, still the new concern has paid for it, and the capital was originally and is now invested on its account. Investors could not be induced to traffic in such an unsatisfactory and unstable security, where the risk is not failure by reason of operation, but failure through confiscation. The benefit that should come to the public is through the reduced cost of operation; but the value of the dismantled plant should not be taken from the books as a capital charge until such time through sale, or other equitable arrangement, such value has been reamortized. So, too,

with respect to the parallel lines in question." (Ben Avon Borough *et al. vs.* Ohio Valley Water Co. Decision of Supreme Court of Pennsylvania, Oct. 8, 1917.)

Paving Over Mains.—In making an estimate of the cost to reproduce a property, allowance has not been made for the cost of paving over mains where the history of the plant shows that the mains were laid before the streets were paved. Such costs would, however, have to be reckoned with in a true estimate of reproduction of the property as of the present time.

Unit Prices.—To the list of properties included in the complete inventory unit prices are applied. The determination of unit prices depends upon whether the basis of the valuation is original cost, present value or some reproduction value. Usually to determine a fair value for rate-making cases, the unit prices used represent an average of prices over a period of years (in most cases five years is taken). The sudden advent of present high prices of machinery and equipment of all kinds has led commissions to postpone the making of valuations "until prices and times are normal," and in fact this marked fluctuation in unit prices has been a factor in reaching the conclusion that complete valuations are not essential in a rate case.

Overhead Charges.—To the property cost obtained by the application of prices to the item of property in the inventory is added, usually as a percentage allowance, an amount to cover overhead charges—that is, costs which are attached to the construction of the property as a whole and not included in unit prices—such costs as promotion, legal expense, engineering, incorporation and organization, interest during construction, early experimental work, contractor's profit, costs of piecemeal construction, contingencies, and allowances for possible omissions in inventory.

INTANGIBLE ELEMENTS OF VALUE.

In addition to the determination of value of tangible property, consideration must be given to intangible values, principal of which is going value.

Going Value is the value which is added to a property by the fact that it is a going concern. In some cases the commission has not made a separate determination of going value, holding that a property with an attached business is of more value than the property without such business, and stating merely that the property has been valued as a going concern.

Other commissions have made a definite addition as a percentage of the physical value or as a separate sum for this element. The estimate has been based upon the actual or estimated cost of developing the business, including costs of soliciting the business and deficits in earnings during development of the business. The objection to this method is that an unprogressive company slow in attaching business would have a greater going value than a more progressive company. Adjustments can be made to a reasonable amount, however, or an estimate may be made of the cost to reproduce the business just as an estimate is made of the cost to reproduce the physical property.

Both courts and commissions have varied widely in the treatment of this intangible element, considering it as a value in one case and as a cost in another.

Considered as a value, the authority may hold that a plant which has an established business is clearly of greater value than an identical property without an established business and where it has not been shown that it is possible to secure sufficient patronage to make a success of the undertaking. It is often added as a conclusive argument on this point that any buyer would pay more for the plant and going business than for the plant without such business.

Considered as a cost, the authorities have pointed out that a business can not be secured without expenditure of time and money. On this basis, as stated above, an allowance may be based on deficits in earnings during the period of business development, or the company may show what it costs to connect a new customer, including such costs as advertising and soliciting new business and the attention necessarily given to the prospective customer in acquainting him with the adaptability of the service to his needs, proper use of the equipment installed on the customer's premises, and similar considerations. This cost per customer is then multiplied by the number of customers attached to the going concern at the time of the valuation.

Good Will.—Going value is not the same as good will, which is recognized as an element of value in competitive undertakings where the patronage can be built up and a business given value by securing the good will of the customers. Good will has never been included in a valuation of public utility property, although the element is a factor in such undertakings. A public utility which has the good will of a community will develop faster, get more business, have less controversial expense, and to that extent be more valuable.

Franchise Value.—While the cost of securing a franchise which the company has actually borne in the form of a special tax or free service to the municipality is allowed, no intangible value attaching to the right to operate on the public streets is included in the rate base on the ground that such right is a grant of the public and should not be capitalized against a service to the public.

Working Capital.—An allowance should be made in the valuation for working capital sufficient to maintain the company's credit, permit purchases to be made at advantageous times and maintain company supplies sufficient for efficient and uninterrupted conduct of the business. The amount of working capital necessary may be determined in each case by an examination of past expenditures, consideration of the value of supplies on hand, the tendency toward increase or decrease in the cost of such supplies, and the time and frequency of the company's collection of bills for service rendered. The cash reserve and value of supplies is as much a part of the valuation as the investment in the property installed, as it represents capital used in the interest of the business of the public utility and withheld from other investment.

ELEMENTS OF VALUE GIVEN SPECIAL CONSIDERATION.

Land.—The same theory or basis of valuation followed in valuing physical property other than land is seldom applied to the value of the land. Land has perhaps most often been valued at its present value estimated by those familiar with real estate transactions in the community or judged by the value placed upon adjacent land.

The present value of the land is in many cases higher than the price paid by the company in acquiring the land. The amount of the appreciation has been considered in some instances as sufficient to cover certain overhead charges incurred in connection with the purchase of land and as reward for the exercise of good judgment in selecting a suitable loca-

tion and securing property adapted to the proper development of the undertaking.

If the property is particularly well adapted to the public use to which it has been put a special value may be allowed as representing that added value to the public service, and as a reward for the exercise of the business sagacity that saw the possibilities in the unimproved land and put it to public service.

The actual purchase price of the land has been considered instead of present value in some cases where the land has depreciated in value. If the purchase price of the land is known and the property values in the community have gone down, the company has not been penalized where it appears that the investment was made in good faith and with reasonably good judgment.

Again in cases where the purchase price of land is used, the company may be denied the return on the appreciated value on the theory that the property is held in public trust and that so long as the land is held for that use the purchaser is entitled only to a return on the money actually invested. But this practice clearly prejudices property in public use as compared with property held where the owner is free to sell at an advantageous price or do what he wishes with the property to bring a return on increased real estate values.

Water-Power Rights.—Another matter which has received considerable discussion is that of value of water-power rights. Some authorities have held that such rights should be entered at the original cost of acquisition. In electric rate cases a comparison has often been made between the cost of operation of the hydroelectric property as compared with steam operation and a value found by capitalization of the saving in operation made possible by the company's water-power rights.

OPERATING EXPENSES.

Investigation to determine reasonable operating expenses, provision for depreciation and the fixing of a proper rate of return are important in any rate case and this work has often been passed over lightly where the importance of valuation has been overemphasized.

The Colorado Public Utilities Commission said: "In the opinion of the Commission the operating expense of a public utility should be as carefully considered as the amount allowed for fair value of the property of the public utility." (Suburban Light & Power Co. rate case, decided Nov. 16, 1917.)

Future operating expense, which must be provided for in the rate ordered, cannot always be judged alone by past records. Allowances must be made for the probable trend of material and labor costs.

An interesting example of rate regulation in which operating expense was made an important factor was that of the decision of the Oregon Commission in the Portland Railway, Light & Power Co. case (decided Jan. 5, 1918). The company applied for an increase in fares; the employes were asking for an increase in wages; and the city was opposed to any increase in fares.

The Commission found that the company was in need of relief and it was suggested that the city grant a modification of certain paving requirements and service exactions which were considered by the Commission to be unjustly burdensome upon the utility service. The decision of the city with respect to lightening operating expenses was obtained, and the wage disputes were submitted to arbitration before the Commission took up the matter of rate adjustments. The Commission said:

"States should so regulate that neither an increase in profits to the utility nor lower rates to the consumers will be given without considering the wages of the employes."

The reasonableness of salaries paid, the reasonableness of payments of subsidiary companies to a holding company for certain service rendered, the possibilities for instituting economies in operation, the proper maintenance and upkeep of the property, the necessity of provision for unusual expenses caused by sleet storms, ice jams, or whatever the hazard may be to which the particular utility under consideration is subject, may enter into the discussion of what are reasonable operating expenses in any rate case.

Increase in Operating Expenses.—The sudden increases in operating expenses of public utilities, due to war conditions, have emphasized the need for greater flexibility in rate systems to maintain a proper relationship between expenses of operation and the rate schedules.

Provision for the automatic variation of the rate with fluctuations in the cost of fuel became quite common during recent times. Coal clauses have been adopted by electric and gas companies and have been generally approved by commissions, which provide that the rates shall be increased or decreased each month to correspond to an increase or decrease from the price as of a certain date for coal or fuel oil as the case may be.

In at least one case, a company applied to a commission to extend this automatic adjustment of rates to provide for fluctuations in total operating expenses. The commission had made a complete investigation of the value of the company's property and operating accounts and had prescribed rates for the company's business in 1912. The company recently asked that the commission take the rates thus established as a base and provide for automatic increase or decrease in those rates corresponding to the increase or decrease in operating expenses from those of that date. The commission refused to adopt such a radical departure from former practice under the exigencies of the war period.

However, there has been at least one new adaptation of this principle which has come to the writer's notice in the form of a wage clause. Starting with the rates as of a certain date and the scale of wages as of that date, the rate supplement provides for increase or decrease in the rate for electric service corresponding to the increase or decrease in the scale of wages paid to the company's employes.

DEPRECIATION.

As soon as property is constructed depreciation must be considered. Ordinary maintenance and upkeep costs do not cover the depreciation of the property. In addition to the regular wear and tear from operation there may be special agents to be reckoned with, such as electrolysis, corrosion, incrustation or decay, which are peculiar to the equipment of the different utilities.

Obsolescence.—Aside from the wearing out of the property there is the more uncertain element of obsolescence. Machinery new or in good operating condition may be hastened on its way to the discard by the appearance on the market of a greatly superior type of machinery. The plant and system may also become inadequate to meet the demands of the com-

munity for service which may require the building of a new plant and the abandonment of much of the old.

Accrued Depreciation.—The question of whether or not the estimated first cost or reproduction cost of the property should be depreciated to correspond to the present depreciated condition of the property has received much discussion in rate cases. Where the deduction for accrued depreciation has been made it has been generally decided that the amount of the depreciation should be determined by actual inspection of the property and not on a theoretical basis considering merely the number of years the property has been in use.

It has been contended by the company in many cases, that if the property has been efficiently maintained so as to furnish 100% service no deduction should be made for depreciation. In support of this view it has been pointed out that a property which has been adjusted and in working order is of more value than an absolutely new plant from the standpoint of quality of service rendered. This claim for undepreciated value has been sustained by the regulatory commission in some cases.

It would seem that the treatment of accrued depreciation is necessarily bound up with the question of whether or not the company has, in the past, earned sufficient to provide for depreciation, and what sort of appropriation the commission will make in the rate case for future accruals to a depreciation fund.

Depreciation Funds.—Considering the inevitableness of depreciation of property, good business practice requires the building up of an adequate reserve against the day when the different portions of the plant and system must be scrapped and new equipment purchased.

Instances have arisen where large varied properties have found that replacements occur with regularity, the property having struck its gait as is said, and that no reserve fund need be carried, the depreciation allowance simply appearing as an enlarged upkeep or maintenance cost, but in most properties a depreciation reserve must be provided.

There are two methods used by commissions in creating a depreciation fund, called the straight-line method and the sinking fund method. The straight-line method calls for the setting aside annually of an amount which, at the time of the expiration of the life of the property, will be sufficient, without interest accruals, to replace the property.

Applying the other method, the sinking-fund method, the amount set aside annually is such that the amount together with interest will replace the property. Commissions have discussed the merits of these two methods and their adaptation to short-life property, a telephone property, for example, or a comparatively long-life property, such as a water utility.

No broad general rule can be deduced from the holdings of the commissions in this respect, it being a matter for determination in each case depending upon the life and present condition of the property, the treatment of depreciation by the company in the past, the maintenance and upkeep of the property taken care of in operating expenses, and the holding of the commission as to whether or not a deduction should be made for accrued depreciation in determining the amount upon which the company will be allowed to earn a return.

In determining an adequate depreciation reserve, account must be taken of the fact that the trend of prices has been upward for a number of years. Where replacements have been necessary during the war period an additional burden has been placed upon the replacement fund because of the high prices of machinery, materials, and labor prevailing. It is not always possible to delay such replacements until prices are favorable as public interest demands safety of service and continuous operation. Allowance for depreciation should be liberal so that the company may be required at all time to maintain its property in good operating condition.

RATE OF RETURN.

The rate of return which the company is to be allowed to earn in fixing rates is more than interest on invested capital. There should be a margin of profit as an inducement to capital to continue to flow into the public utility industries, and a compensation or reward for efficient management and skillful economic operation.

Other factors which have been given consideration by commissions in fixing rate of return are hazards and risks in the business, bond discounts, effect of political interference and popular whim, and the necessity for allowance to cover possible undervaluation of the property.

Attracting Capital.—Capital cannot be forced to invest in public utilities, but must be attracted in the open market by the offer of security of investment and an adequate rate of interest. During the war period, the utilities have had to compete in a restricted market with other industries offering high rewards.

The California Commission recognized the advantages accruing to the public from the adoption of a liberal policy in fixing the rate of return. The following excerpt from the Palo Alto Gas Co. case (Vol. 2, Opinions and Orders of the Railroad Commission of California, pp. 300, 317) has been cited by the Commission in subsequent decisions and may be quoted as an expression of its policy.

"The Commission in fixing a rate of return must be liberal, lest too strict a policy result in turning capital to other fields of enterprise. California needs development of public utilities, and this Commission's policy should be a broad and liberal one, so as to encourage capital to develop the state by legitimate public utility enterprises where needed. The Commission should be careful not to permit an inflation of prices in ascertaining the value of the property of a public utility used and useful for the public purposes; but should be liberal in establishing the rate of return on that value."

The Michigan Railroad Commission in the Michigan State Telephone Co. rate case, discussing the need of capital in the public utility field, said:

"It is important, therefore, to the development and extension of public service, that the exercise of the power of public regulation be such as will not discourage the investment of new capital in such enterprises. The destruction or serious impairment of the value of securities issued by such companies, by undue limitation of rates, would strongly tend to discourage such investments, and this would result in inevitable and serious public injury through the impairment of the service adequate to the constantly expanding needs of the public. The exercise of the power of public regulation should promote the confidence of the public in public service securities, rather than constitute a menace to such securities. The State does not guarantee public utilities against losses nor insure them any specific rate of return upon their investment. While costs of operation and maintenance—costs of new material and labor—fluctuate

with changing conditions of production and use, there should be some margin allowed to public utilities, over bare present costs, and those happenings which can be foreseen and estimated with reasonable certainty." (Decision rendered Jan. 30, 1918.)

The Oregon Public Service Commission, in the Portland Railway, Light & Power Co. case, decided Jan. 5, 1918, said:

"If the rates fixed by the Commission, while sufficiently high to escape condemnation by the courts as confiscatory, will yield only a return insufficient to attract capital into needed public service, it is the public and not the investor who will suffer."

The Illinois Commission in the Chicago, North Shore & Milwaukee Railroad Co. fare case, decided Sept. 5, 1917, said:

"Legislation cannot compel the investment of funds in a concern, and only the opportunity to earn sufficient to attract investors will avail in obtaining support for any enterprise. Without its support the enterprise will perish and a community may thereby be deprived of a necessary service."

Business Risks and Reward to Management.—The Illinois Public Utilities Commission in the rate case of the Central Illinois Public Service Co., fixed the rate of return, "after giving due consideration to the circumstances governing this case, including the character of the service, the hazards connected with the business, and the cost of securing capital; and further taking into consideration the testimony regarding the degree of ability displayed by the management which was found to compare favorably with that shown by other small gas utilities in the state of Illinois."

The Maine Public Utilities Commission said:

"The rate of return on the value of the property in a rate case must be sufficient to compensate and attract money to such undertakings under the conditions as to business risk, etc., which existed in the beginning. If the rate of return is reduced from time to time as it appears that the risk in that particular undertaking in the light of developments was less than might reasonably have been expected, or has been eliminated by successful management, it would practically amount to a penalty for skillful administration." (Maine and New Brunswick Electrical Power Co., *et al.*, purchase case, decided Dec. 4, 1917.)

The Illinois Public Utilities Commission in the Union Gas & Electric Co. rate case, decided Jan. 16, 1918, found proof that the utility had been ably directed in its policies and efficiently managed, and the Commission said:

"Where causes of an opposite character have produced poor results the Commission has not hesitated to conclude it had cause to penalize a utility by reason of such poor management. A rule of this kind should operate both ways, and it is considered just in this case to recognize, in a substantial way, that good management should not be penalized but ought to be further encouraged. It is realized that a utility can very materially control the cost of production in more ways than one, and if the expense per unit of service is reduced by reason of an increase above the normal in the sales per customer and per capita, the company should be given some incentive to maintain its good record. Any proof that is made of excellence in the operation of a utility ought to entitle the operators, as well as the holders of the securities, to a reward for their meritorious work."

Undervaluation of the Property.—In the Addison Gas & Power Co. case, decided Feb. 28, 1918, the New York Second District Commission estimated that the rates prescribed would yield a return equal to 8.6% of the value of the property, and the Commission said: "This is not inordinate in itself, and permits a small margin to cover any possible undervaluation of the property."

Bond Discount.—In some cases commissions have allowed for bond discounts in fixing the value of the property by considering it as a necessary cost of building up the property, while in other cases bond discount has been considered as an interest charge to be taken care of in the rate of return.

The Supreme Court of Pennsylvania, in reviewing the decision of the Pennsylvania Commission in the case, Ben Avon Borough *et al. vs.* Ohio Valley Water Co., said:

"Concerning the item of brokerage, the courts and commissions of other states have held that discounts on securities should be allowed, as utilities, like other companies, are not able to make their financial arrangements without allowing such discount. The difference between the amounts derived from the sale of its bonds and the amount which the company must eventually pay on the bonds has been regarded as a part of capital charges for construction. While corporations should not be permitted to capitalize their lack of credit, still, where bonds are sold at a reasonable discount and bear a fair rate of interest, such discount should be allowed."

In the Chicago, North Shore & Milwaukee Railroad Co. fare case, decided by the Illinois Public Utilities Commission, Sept. 5, 1917, the company submitted a valuation of its property to the Commission in which an amount was included for bond discount during the construction period. The Commission said:

"It is believed, however, that a more equitable disposal of the matter of bond discount may be had by considering it as a form of interest. Doubtless, a utility, by making its interest rate sufficiently attractive could dispose of its bond securities at or above par, but this basic principle would not be vitiated should it choose to fix a lower rate of interest and thereby be compelled to dispose of its bonds at less than par. The effect has been merely to change the rate of return which it provides upon such securities. This idea is well expressed by the District of Columbia Public Utilities Commission, *in re* Potomac Electric Power Co., wherein it is said 'Bond discount, constituting a payment for the use of money, is in the nature of an interest payment; that is, it is not a proper capital charge but rather an adjustment of the interest rate to the existing market conditions and chargeable to interest account, and not capital.' The Commission is of the opinion that brokerage and bond discount are matters to be considered in connection with, and to be reflected in, the rate of return allowed; that such costs should be made up out of income by the creation of a sinking fund or reserve sufficient to cover the cost during the life of the bonds; and that, therefore, such costs should not in equity be considered a part of the cost of reproduction or of the 'fair value' to be taken as a base for the fixing of rates.

"This Commission is of the opinion that the doctrine thus enumerated is sound and affords a proper disposal of the matter of bond discount."

Surplus.—The wisdom of following a liberal policy in the fixing of a rate of return has found ample illustration under war conditions. Where the companies have been held down to a close margin

hardship has been experienced under the increase in operating costs which could not be prevented entirely by emergency increases. While in the case of other properties it has been possible to tide over the period of high costs to some extent by the surplus built up under more normal conditions, commissions in granting emergency increases have held that it is impossible to maintain the rate of return earned previous to the war period and have held that the hardships must be borne jointly by the public and the utility. They have also pointed out that utility rates should not fluctuate with every rise and fall in costs. The steady rate level cannot be maintained by the company in a period of high costs unless a surplus has been built up in a preceding period, and if such surplus is not sufficient a portion of the loss in net earnings during the period of high costs may be spread over the years following a reduction of operating costs to normal.

The Oregon Commission in the Portland Railway, Light & Power Co. case, decided Jan. 5, 1918, said:

"Under state regulation of rates no utility is permitted to earn a surplus during good times by which to carry itself over the lean years which may lie ahead of it. Rates must at all times be kept down in conformity with the value and the cost of service rendered. Justice, therefore, requires that when costs go up, rates should do likewise. * * * No starved horse ever pulled a heavy load. The utilities have been deprived of the power to make unjust profits. They must also be protected against unjust losses. If a utility is driven into a position where its credit is impaired and it can obtain money for operations and extensions only at unreasonable cost, the public must share the loss."

However, some commissions have adopted a policy of providing for the building up of a surplus in the rate of return, to provide for unforseen contingencies and to guard against the necessity of adjusting the rate to correspond with every fluctuation in price. For example, in the case, City and County of San Francisco *vs.* Pacific Gas & Electric Co., decided by the California Railroad Commission, Oct. 8, 1917, the Commission said:

"In permitting this return, we do so with a frank realization that it allows a liberal margin over the cost of money. We are animated in doing so, not merely by a desire to be fair to the company, but also in part by the uncertainty as to whether the price of fuel oil will not further advance and by the desire to create a margin of profit which will take care at least for a time, of such further advance, if it occurs."

(THE END.)

NORTHWEST PLANTS FOR FIXATION OF ATMOSPHERIC NITROGEN.

The American Nitrogen Products Co., of Seattle, Wash., is now operating two plants in the Northwest for the production of nitrites and nitrates from the nitrogen of the atmosphere. The first plant, which has been in use most of the time during the last two years, was built in Nisqually canyon, at La Grande, Wash., and has a capacity of 125 tons of product per month. Electrical energy is derived from the municipal hydroelectric plant of Tacoma. The second plant, having a capacity of 100 tons per month, was built at Vancouver, B. C., and was completed in November of this year. Electric power for this plant is supplied by the British Columbia Electric Railway Co. In each case the nitrogen plant was constructed in close proximity to the power plant to obviate the expense of building and maintaining transmission lines.

Energy for the electric arc, in which nitric oxide is produced by the combination of nitrogen and oxygen of the air, is conducted into a double-tube furnace, from both ends, at 6600 volts. Air is forced into these tubes by motor-driven fans, entering at the center. This volume of air, on entering the furnace, is forced toward both ends and into the field of the electric arc in which heat is generated at 5400 deg. F. The space between the inner and outer walls of the furnace is kept full of flowing water to prevent the destruction of the tubes by intense heat. The nitric oxide product passes from the furnaces to a cooler, thence to a vat in which dissolved soda ash and the nitric oxide are combined to form a nitrite solution. This nitrite solution is held in the vats about 8 hours, after which it is drawn off into cooling trays where evaporation of the water takes place, resulting in a nitrite product, which after being dried is in the form of a white powder. In the Vancouver plant nitric acid is produced.

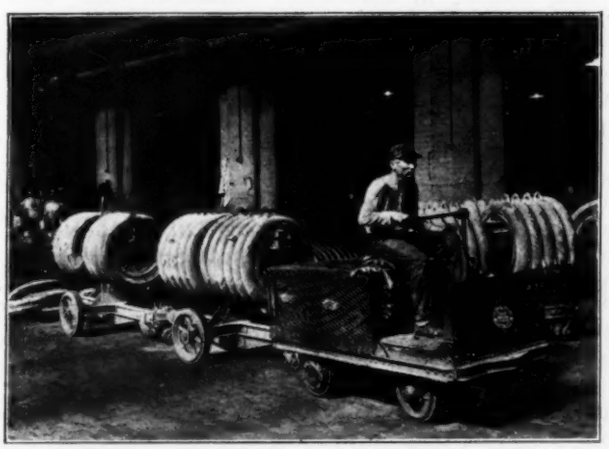
The processes by which nitrites are produced are applied, with only slight variations for the production of nitrates. But for the industries in which those products are required about 96% of the demand is said to be for the nitrite.

It is intimated that this company may erect hydroelectric plants to meet plans for a much heavier production and that water-power rights have been acquired with that purpose in view.

EXCELLENT RECORD MADE BY ELECTRIC INDUSTRIAL TRACTOR.

Herewith is an illustration of the first electric factory tractor operated at the big Akron, Ohio, plant where Goodyear tires are made. For six years this truck has been operated in Department 150B and has traveled approximately 180,000 miles.

The outfit hauls a load of 3,100 lbs. on each trip,



Electric Tractor That Has Traveled About 180,000 Miles in Hauling Tires About Large Goodyear Plant.

making a trip once every four minutes about the department. In one eight-hour shift it pulls over 200,000 lbs. of tires and cores, doing the work that it formerly took 25 men to do.

In all, there are 25 electric trucks and tractors at the Goodyear works. The three types used are the self-loading truck, the tractor and the flat freight truck.

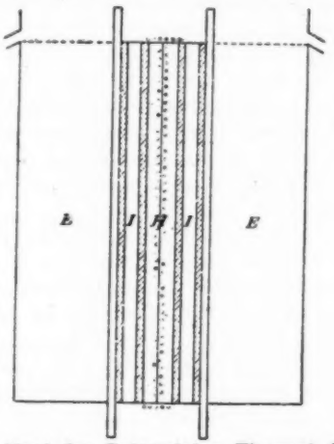
Thermal Conductivity of Insulating and Other Materials

Outline of Method of Carrying Out Tests—Tabulated Results of Thermal Conductivities—Summary of the Results

THE thermal conductivity of materials is important because it determines the ability of the materials to absorb or dissipate heat. In a paper entitled "The Thermal Conductivity of Insulating and Other Materials," presented before the New York meeting of the A. S. M. E. this month, T. S. Taylor Westinghouse Research Laboratory, described a large number of tests carried out to determine the thermal conductivity of a large number of insulating materials. The tests were very extensive and considerable effort was made to obtain accurate data. The data obtained is given in the accompanying table.

The thermal conductivity was determined by what the author terms a "thermal meter." This is shown in the diagrammatic sketch to consist essentially of an electric heater *H* constituting two hot equitemperature surfaces or sources of heat and two cooling chambers *E, E* (one on either side of the heater) or cold constant-temperature surfaces. The heat generated in *H* passed laterally through the samples *I, I*, of a given material to the cold reservoirs *E, E*. The heater was made from two disks of soapstone 9 ins. in diameter and 3/8 in. thick. Each disk had a spiral groove of 3/16-in. pitch cut in one face. A heater wire of No. 21 constantan, was wound and cemented securely in the groove of each disk and then the iron disks were cemented together with the sides containing the heater wire adjacent. The two heating elements in the two disks were joined together at the center by means of a peg in one disk being pushed into the spring contact in the other. Potential leads were brought out from each heating element at points 2 ins. from the centers. It was later found that potential leads fastened to the heating elements at the points where the wire started in the outer terminals of the spirals served equally well, since the temperature coefficient of resistance of the constantan wire is very small and furthermore the temperature of the heater was constant over its entire face. Extra turns of wire were wound around the outer edge of the heater in order to prevent the loss of the heat generated in the heating element proper through the edge of the heater. After several trials it was found that this procedure gave a heater which in use had a very constant temperature over its two faces, even up to the outer edge.

Two samples of the material to be tested were always used, each being 9 ins. in diameter and from 0.1 to 0.75 in. thick, depending upon the nature of the material. One sample was placed on each side of the heater, *I, I*. Extra disks of lagging of the same material of the sample or something else suitable were placed on each side of the sample, as shown by the shaded portions in the diagrammatic sketch of the thermal heater. This made the ultimate drop at high temperatures less than it otherwise would have been and likewise gave a wider range of mean temperature. The faces of the cold reservoirs *E, E*, constituting the cold equitemperature surfaces, were made of heavy brass having a diameter of 10 ins. The samples, heaters and cold reservoirs were held securely together by means of bolts extending between these two plates. At first strong spiral springs were used around these connecting bolts to insure uniform pressure, but it was found later that equally satisfactory results could be obtained by merely turning down the nuts on the bolts till the samples, etc., were drawn tightly together. Thermocouples of 5-mm. copper-constantan wire were inserted on each side of the samples, *I, I*. under test. Great care was taken in order to insure good contact between the sample and the thermocouple junction. Two couples were placed on each side of a sample, one at the mid-point and another about 1½ ins. from the center. The electromotive



Thermal Unit Used for Determining Thermal Conductivities.

force of the couples (the cold junction being always kept at 0 deg. C.) was measured by means of a thermocouple potentiometer. The current in the heater was likewise measured by the same potentiometer by measuring the drop through a standard resistance placed in series with the heater. The potential drop per unit length of heater wire was also measured by means of the potentiometer. This necessitated placing a high resistance in parallel with the heater and then measuring the potential drop across a small fraction of this. The current was supplied by a storage battery and consequently remained quite steady. The cold equitemperature surfaces *E, E*, were maintained so by having water from the tap circulating through them continuously. The outer edges of the samples and heater were surrounded by felt in order to prevent undue loss of heat from the edges of the heater and samples.

By putting vaseline, glycerine, glue, shellac or a similar material on the division between two surfaces the thermal drop due to such division can be largely eliminated. This is particularly true for poor conductors.

The thermal conductivity has been measured for a large number of materials both across and along the laminations. For the poor conductors the ratio of

the longitudinal to the transverse conductivity varies from 2 for black bias cloth to 5½ for mica tape.

The temperature coefficient of thermal conductivity has been measured whenever the experimental results justified doing so.

Of the electrical insulating materials tested, those containing mica have in general the better thermal conductivity.

As a thermal insulator soft pine is the best of the woods tested and is but little inferior to dark-gray felt.

The transverse conductivity of iron stampings can be increased some three or four times by the insertion of some suitable material between the stampings so as to make better thermal contact. This is for a pressure of about 50 lbs. per sq. in. Nothing destroying the electrical insulation could be used, however. By using something between sheets the ratio of the longitudinal to transverse conductivity could be reduced to 20 to 25 instead of 80 to 100.

In general, the thermal conductivity of laminated products can be considerably increased by suitable impregation so as to get rid of the air film.

Oil-soaking soft fuller board increases its thermal conductivity by about 50%.

For the best thermal insulation for a given thickness it would be better to make it up of several thin

Material, thickness in in.	Thickness of sample, in.	Sp. gr.	Direction of heat flow.	Temp., deg. cent.	Cal. per cm. per deg. cent. per sec. × 10^{-4}.	Watts per in. per deg. cent. per sec. × 10^{-4}.	Temp. coef. × 10^{-4}
Fish Paper		1.06	Trans.	20	410	435	19
0.010	0.212			20-85	433	462	
0.010	0.748	1.06	Long.	20	1,150	1,222	19
				20-80	1,215	1,290	
0.023	0.222	1.03	Trans.	20	482	512	24
				20-85	517	548	
0.056	0.355	1.01	Trans.	20	567	602	21
Paraffined Fish Paper		1.06	Trans.	20	460	489	18
0.007	0.211			20-80	483	513	
0.015	0.225	1.13	Trans.	20	520	553	
				20-90	525	558	
0.038	0.299	1.15	Trans.	15-30	494	525	
Fuller Board, Treated—							
0.020, dark	0.230	1.39	Trans.	20	384	408	30
				20-90	418	444	
0.030, dark	0.500	1.15	Long.	20	1,450	1,540	50
				20-80	1,650	1,750	
0.056, green	0.227	1.09	Trans.	20	357	380	30
				20-100	396	421	
0.125 green	0.254	0.95	Trans.	20	339	361	16
				20-80	350	372	
Fuller Board, Untreated—							
0.015	0.232	1.38	Trans.	20	640	681	
				20-80	641	682	
0.30	0.216	1.26	Trans.	20	610	649	9
				20-80	628	667	
0.30	0.500	1.28	Long.	20	1,500	1,590	17
				20-80	1,580	1,680	
0.010	0.210	1.39	Trans.	20	622	661	10
				20-90	690	735	
0.056, light grey	0.217	1.15	Trans.	20	465	495	60
				20-60	515	548	
0.056, light grey	0.500	1.15	Long.	20	1,520	1,620	26
				20-80	1,650	1,750	
0.125, light grey	0.365	1.01	Trans.	20	347	369	33
				20-80	387	412	
Fuller Board—							
0.125, light grey, soaked in transformer oil	0.365	1.01	Trans.	20	507	540	16
				20-80	543	577	
0.125	0.520	1.01	Long.	20-80	1,230	1,310	
Varnished Cambric			Trans.	20	517	550	
0.009, tacky	0.263	1.17		20-95	544	578	10
0.009, tacky	0.694	1.17	Long.	20	1,027	1,093	
				20-100	1,046	1,113	5
0.009, dry	0.275	1.24	Trans.	20	516	549	
				20-90	532	565	9
Cement Paper			Trans.	20	304	323	
0.015, plain	0.216	0.62		20-90	322	342	17
0.018, treated	0.211	1.02	Trans.	20	372	395	
				20-80	395	420	21
Mica Tape—							
0.006	0.201	1.06	Trans.	20-80	630	670	
0.008	0.229	1.12	Trans.	20-80	630	670	
0.006	0.768	1.06	Long.	20-80	3,470	3,680	
Black Bias Cloth—							
0.009	0.209	1.26	Trans.	20-100	600	621	
0.009	0.782	1.26	Long.	20	915	975	
				20-100	1,027	1,091	50
Cement Paper and Mica—							
No. 226	0.223	....	Trans.	20	443	472	
				20-80	462	491	14
No. 227	0.1385	....	Trans.	20	465	494	
				20-100	498	530	15
No. 247	0.225	....	Trans.	20	501	533	
				20-80	522	555	16
No. 227	0.512	....	Long.	20	2,230	2,370	
				20-80	2,360	2,510	20
Micarta Folium—							
No. 249	0.233	....	Trans.	20-100	553	588	
	0.569	....	Long.	20-100	2,700	2,870	
Kraft Paper and Mica—							
No. 312	0.220	....	Trans.	20-100	545	579	
	0.520	....	Long.	20	2,680	2,830	
				20-100	2,840	3,020	16
Fish Paper and Mica—							
No. 230	0.195	....	Trans.	20-100	483	514	
No. 232	0.233	....	Trans.	20-100	475	505	
No. 233	0.237	....	Trans.	20-100	451	481	
Pressed Mica Plates—							
0.41 in white	0.201	2.34	Trans.	20-100	623	663	
0.41 in. yellow	0.203	2.41	Trans.	20-100	550	585	
0.032 in. white	0.1915	2.32	Trans.	20-100	675	718	
0.032 in. yellow	0.1915	2.41	Trans.	20-100	580	617	
0.025 in. white	0.1995	2.43	Trans.	20-100	725	771	
0.025 in. yellow	0.1996	2.26	Trans.	20-100	612	650	
Micarta	0.247	1.36	Trans.	20	606	645	
0.125 in.				20-90	620	660	6
Hard Rubber	0.380	1.19	Trans.	25-50	380	404	
White Fiber	0.383	1.22	Trans.	20	663	705	
				20-80	695	728	12
Woods—							
White pine	0.519	0.45	Across gr.	20-120	255	271	
White pine	0.732	0.45	Along gr.	30-80	613	652	
White oak	0.516	0.60	Across gr.	20-80	455	484	18
White oak	0.754	0.60	Along gr.	40-70	944	1,003	
Maple	0.733	0.72	Along gr.	20	1,015	1,078	
Maple	0.733	0.72	Along gr.	20-80	1,037	1,100	8
Maple	0.508	0.72	Across gr.	20-80	434	462	
Asbestos—							
⅛ in sheet	0.344	0.894	Trans.	22-80	395	420	
0.025 in. paper	0.306	0.98	Trans.	20	345	367	
				20-100	375	399	24
0.035	0.356	....	Trans.	20	666	708	
				20-80	685	728	14
Board	0.507	1.93	Trans.	20	1,780	1,890	
				20-90	1,950	2,080	14
Plate Glass	0.252	2.49	Trans.	20	1,785	1,900	
				20-100	1,945	2,070	18
	0.289	2.60	Trans.	20	1,905	2,024	
	0.289		Trans.	20-120	2,016	2,142	12
Soapstone	0.715	2.87	Trans.	70-130	8,000	8,500	
Sheet Steel—							
0.0172 in M. A.	0.415	....	Trans.	20	1,370	1,455	
Varnished	....			20-80	1,430	1,520	19
Unvarnished	1.48	....	Long.	40-100	103,000	109,500	6
				40	101,300	107,700	
With asphalt paint on sheets	0.420	....	Trans.	20	4,710	5,020	
			Trans.	20-80	4,850	5,160	10
Unvarnished	0.416	....	Trans.	40	1,480	1,570	
0.0172 in.				40-100	1,580	1,680	25
Same with asphalt paint	0.425	....	Trans.	40	6,360	6,750	
				40-100	6,520	6,930	9
W. A. Silicon Steel—							
0.014 in.	0.419	....	Trans.	40-80	1,270	1,350	16
Varnished	....						
Unvarnished	1.44	....	Trans.	40-100	41,800	44,400	19
				40	39,500	42,000	
Same painted with asphaltum	0.422	....	Trans.	40-80	4,640	4,920	10
Unvarnished	0.440	....	Long.	20	1,340	1,420	
				20-100	1,470	1,560	25
Same painted as above	0.443	....	Long.	20	4,200	4,470	
				20-100	4,520	4,810	17
Sil-O-Cel	0.977	0.495	Trans.	30	242	258	15
Brick	....			30-150	262	279	
Powdered	0.955	0.15		30	208	222	31
				30-150	242	258	
Wool Felt—							
Dark grey	0.98	0.15	Trans.	40	149	159	76
				40-100	175	186	
Graphite—							
Solid	1.04	1.58		50	105,500	112,200	12
				50-130	110,200	117,200	
Powdered, through 20 mesh on 40 mesh	0.476	0.70		40	2,850	3,030	
				40-100	3,200	3,400	48
Powdered, through 40 mesh	0.476	0.42		40	922	980	
				40-100	1,007	1,080	40
Powdered, through 100 mesh	0.476	0.48		40	438	467	
				40-100	482	513	34
Lampblack—							
Eagle Brand Germantown	0.476	0.165		40	156	160	
				40-150	166	176	6
Coal Dust	0.476	0.73		30	265	282	
				30-150	298	317	23
Iron Dust and Sand	0.377	1.14		30	460	489	23
				30-150	517	550	

sheets rather than of a single sheet. This effect is more pronounced the better conductor the material is.

A layer of dust, say, coal dust, upon the surface of a body will increase its internal temperature by ⅓ deg. C. per watt flowing through unit area.

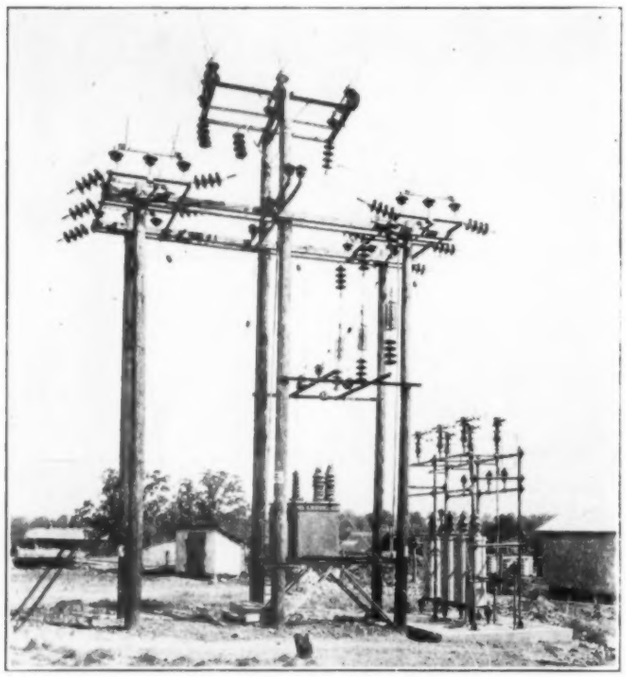
FRANCE AND BELGIUM USING ASHES AS FERTILIZER.

It has been found that the ashes from glass, iron and steel works and allied industries stimulate vegetable growth enormously through carbonic acid fertilization. The technical body working for the restoration of France and Belgium have found that plant life can be spurred by this means to unusual growth. It is proposed that ashes from the industries as above mentioned be used for refertilizing the devastated areas of Belgium and France.

NOTEWORTHY INSTALLATION OF 33,000-VOLT SWITCHING CENTER.

Features Are Simple Design and Construction, Flexible Operation and Neat Appearance.

The accompanying illustration shows a recent installation of a 33,000-volt, 3-phase outdoor switching station with one incoming line, one outgoing line and a third line to a stepdown substation which supplies power to a local load. The features of this installation are that it is free from complicated design or operation, insures flexible operation and is of good appearance.



33,000-Volt Switching Center.

An electrolytic arrester is so connected as to drain lighting disturbances from the transmission system. The metering equipment is connected to the incoming line of the transmission system, and the power taken from the high-tension side is thereby recorded; if the meter were connected on the secondary side the transformer losses would not be recorded.

The three-pole, double-break-per-phase, air-break switches are operated from ground level by means of remote-controlled interlocking mechanisms which are equipped with handles which can be locked in either open or closed position.

The arresters and metering equipment were supplied by the General Electric Co., the strain and wiring insulators by the Locke Insulator Co., and the air-break switches and choke coils by the Delta-Star Electric Co.

COAL CONSUMPTION BY UTILITIES IN CHICAGO AND SUBURBS.

Investigation carried on previous to the coal strike brought out the fact that 3,200,000 tons of coal were consumed in Chicago during the year 1918 by utilities supplying light, heat and power.

The Commonwealth Edison Co. consumed 1,962,960 tons of coal and the Public Service Co. of Northern Illinois, which supplies the outlying suburbs adjacent to Chicago, with electricity and gas, consumed 364,970 tons of coal for generating electricity and 40,290 tons for producing gas in addition to 11,601 tons of hard coal, 62,637 tons of coke and 12,033,258 gallons of fuel oil. The Peoples Gas, Light & Heat Co., which supplies the city of Chicago with gas, used 194,368 tons of soft coal, 138,979 tons of hard coal, and 302,599 tons of coke. In addition it used 89,515,690 gallons of fuel oil and 2,573,145 gallons of fuel tar in gas production.

In consuming 1,962,960 tons of coal total, the Commonwealth Edison Co. generated 1,490,000,000 kw-hrs., or an equivalent of about 2.63 lbs. of coal per kw-hr. It should be borne in mind that while this result is very good, so far as fuel economy is concerned, the actual result is really better than at first appears, for of the total coal used, not all was used for producing electricity.

VENEZUELAN GOVERNMENT TO ERECT LARGE WIRELESS STATION.

The government of Venezuela advertises for sealed bids addressed to Ministerio de Fomento de los Estados Unidos de Venezuela to be submitted before June 30, 1920, and marked (in Spanish) "Bid upon wireless telegraph."

The station is to be located in the vicinity of Caracas. It must be sufficiently strong to communicate with similar stations in the United States and Europe. It must have one installation for emission of sustained waves served by high-frequency alternators and another for the emission of damped waves to communicate with wireless stations not provided with the system of sustained waves.

Alternating, tri-phase electric current now distributed at 190 volts and 50 cycles is available, but the plant must have a reserve motor generating capacity.

Bids should show the general plan of the installation and detailed plans and cuts necessary to give a complete idea of the work; a general description of the machines and of their operation; time required to complete the work and the detailed and total cost. The government will pay quarterly, according to the progress of the work, reserving 10% of each payment until final completion. Bidders must undertake to manage and operate the plant for six months after completion. Bids should not include the cost of transmission lines for the current nor of telegraph lines to Caracas.

Editorial Comment

Lessons of Christmas Shopping

EVERYONE is agreed that this year's Christmas shopping has exceeded in magnitude everything heretofore experienced in this line in this country. After the depressing influence of the war and the uncertainties of the early months following the armistice, which reduced the volume of Christmas purchases for several years, we have found ourselves generally in quite a prosperous condition.

There has been an unusually large percentage of the more expensive gifts bought. Costliness has proven of little hindrance and in many cases it has been overcome by the plan of partial payments. Not only have phonographs, pianos, diamonds, etc., been sold on this basis, but also many electrical appliances. In fact, adoption of this plan accounts partly for the large volume of electrical sales. The chief reason for the record-breaking sales of electrical appliances, however, is the high intrinsic value of these devices.

This last feature deserves still greater emphasis in the future. An extremely large part of each year's Christmas shopping still consists of practically valueless trinkets and trivialities. The electrical industry must show how far greater appreciation of a gift is experienced when it is a useful one, such as an electric washer, cleaner, floor or table lamp, percolator, toaster, flashlight or similar device.

The Form of Public Ownership in Which We Believe

SPEAKING at the convention of investment bankers at St. Louis, O. B. Wilcox made a few statements that should serve to bring to many a different feeling toward public ownership. He said:

"About $15,000,000,000 capital, representing a considerable part of all the savings of the people of the country, are invested in public utilities. The securities representing these savings are held by thousands of investors, large and small, and by nearly every bank and financial institution of the country, and in endowment funds of churches, colleges, schools, hospitals, and in other trust funds. The integrity of these investments is of direct or indirect consequence to every citizen; and the maintenance of the service and the expansion of the time and money and labor-saving devices of public utilities is incalculably important to every man or woman with an industrial interest in the country whether as investor, employer or wage earner."

We hear so much said against the capitalist. We are hearing so many declare against private ownership as contrasted with the public ownership or ownership by municipality, state or nation. We have often pointed out before that everyone with one or more dollars in the bank is a capitalist just as is everyone with money invested in anything, whether a utility, a store or a shoe shine parlor.

When we hear demagogs damning the capitalist and the public utility and the politician calling for the revocation of franchises and operation by the people, it would be well to remember how many individuals, who, as stockholders of public utilities, are affected.

Coal Prices and Methods of Burning

IT IS a well established law that the price of any commodity is determined very largely by the supply and the demand. There are exceptions to this statement, of course, for example, the cost of electrical energy from the central station costs less the greater the demand. But in the main, however, the statement is true as the coal situation, the sugar situation and similar situations during the last few years have emphasized in an unpleasant way.

Apropos of coal, we have all seen and felt the increasing costs of all grades of coal. Many of us have encountered the rising price of some certain grade or size of coal, first finding that the cost per ton was gradually rising, and then that this same size and grade commenced to become scarcer. The explanation is as that given above—that the supply and demand are the factors that very largely determine the market price.

Screenings once were cheap. There was little demand for this size of coal because boiler-room practice had not assumed the status it has today. There was a very limited market for screenings, and the mine operators were glad to get rid of screenings at a loss rather than have large quantities of this grade of coal around. The demand was very limited, screenings were somewhat of a glut upon the market, and screenings were cheap.

Screenings being cheap, the demand for screenings increased as boiler-room practice developed and evolved efficient methods for handling and burning this size of coal. The demand for screenings increased and the price increased. Whereas formerly the mine owners had sold screenings at a loss, a loss taken care of by purchasers of other grades and sizes of coal, the mine owners found they were able to increase the price of screenings so that the sale became profitable. The supply and demand argument also offered an excuse for a still higher price for screenings. Today

screenings are no longer cheap, but neither is any size or grade of coal.

The demand for screenings has grown to one of such magnitude that the large consumer of coal is already looking around for some other size of coal less generally applicable than screenings, hence one that is in less demand and therefore of lower price per ton. Just as pulverizing of coal has enabled culm and low-grade coal high in ash, sulphur and extraneous matter to be used, so has mechanical draft brought about considerable latitude as to the choice of fuel that can be burned, a latitude still further extended by the evolution of the underfeed type of stoker. Looking at the coal situation from this aspect—that of turning to lower grades of coal, and developing apparatus for burning them—one immediately realizes that much has already been done.

By means of the underfeed stoker it has been possible to increase the combustion rate, pounds of coal per square foot of grate area, several hundred per cent; in this way higher rates of evaporation have been enabled to be obtained on the one hand and lower grades of coal to be used on the other without loss of steam-making capacity. High rates of combustion have been made possible only by the employment of comparatively high draft intensities, calling for forced and sometimes induced draft as well. This has brought with it high temperatures and the formation of clinker and usually increased loss of combustible in the ash. These things have, in turn, resulted in the development of the clinker grinder, the reciprocating grate, the power dump, and the air-cooled clinker-proof furnace walls.

So it goes. New conditions arise and new apparatus is evolved to meet them. A grade of coal is plentiful and cheap because there is no demand for it and it occurs incidentally to producing other grades of coal. Apparatus is evolved for using it and the demand grows until the price becomes sufficiently high to encourage other grades of coal lacking a market to be used. The time is ripe now for power plant designers and operators to turn attention to the feasibility of using the culm banks, of mixing the various dusts now wasted in mining, the lignites, peat and briquettes. The use of some of these fuels should receive great impetus within the next few years. And this in turn will perhaps start on the way upon a large scale, the large power plant directly at the mine. If these things come out of the bituminous miners' strike, that strike may be considered after all as a blessing in disguise.

Development of Automatic Control

AUTOMATICALLY accomplishing things is undoubtedly one of the features of the times. Instances of this are legion, in the multiplicity of fields of our industrial endeavor, and every phase of our civic life. Just as machines are replacing men, *genus homo*, so are automatic features of machines taking the place of human supervision, human effort for operating and controlling these machines.

The statement was recently made by an authority that the next war will find available aeroplanes capable of flying more than one hundred miles and back and dropping bombs, both actions being automatic and controlled from a distance. And there are many more automatic features connected with war. To come closer to everyday existence, we would cite a paper presented before the A. I. E. E. early this month by A. Bessey Smith on the applicability of automatic switching to all classes of telephone service in which it is shown that the limitations have not yet been reached. Automatic telephony is making rapid headway and before another ten years have elapsed we may expect to find the telephone girl much less of a necessity than she is today.

Into many manufacturing processes automatic features of control are vital to the uniformity and quality of the product. Such industries are the treatment of steel, the preparation of many foodstuffs, and the production of many finished articles. And perhaps not the least of these is the electrical industry, the central-station industry especially.

Into the production and marketing of kilowatts automatic functioning is found at almost every step. The overspeed of steam and hydraulic turbine is automatically controlled. The circuit-breakers are usually automatically operated. Tirrill regulators maintain bus pressure or pressure at the end of a line in the smaller stations. Feeders have their voltage regulated according to load and power-factor at any specified location in the feeder. Automatic control sometimes permits loss of voltage on one line to be picked up by another. Short circuits may be automatically suppressed on long-distance transmission lines; synchronous condensers operate and correct for low power-factor miles from the generating station and miles from human supervision, and distant plants are automatically started up. Along the electric railroad, stations housing synchronous converters or motor-generators may be started up when approaching trains reach a certain stretch of track and shut down in due time, while in the coal mine and the industrial plant, on the wharf, in the steel mill, grain elevator and scores of other plants automatic electrical control is perfecting processes, cutting costs and doing better than could be done in other ways.

Electricity permits of ready control, to such an extent that water, gases, temperature, pressures and motion are often measured and controlled electrically because of the accuracy, simplicity and reliability thus obtained. Automatic control is prone to play an even more prominent part in the scheme of things as the years go on. It is electricity that makes so many automatic features possible. And it is to the manufacturers of apparatus and the manufacturers of electrical energy that one looks to hasten matters along.

Current Events

Clearing of Renewable-Fuse Status — Vacuum Cleaner Makers Organize—Conference on Industrial Safety Codes

LIGHTING FIXTURE MANUFACTURERS AND DEALERS TO MEET IN DETROIT.

Chandelier Show and Fixture Market to Be Held Throughout Week of Feb. 9, Together with Meetings of Producers and Dealers.

Special preparations are being made for making the next meeting of the National Council of Lighting Fixture Manufacturers a memorable one. The meetings of this organization will be held each morning at 9:30 o'clock from Tuesday, Feb. 10 to Saturday, Feb. 14, inclusive. Some of the sessions will be joint meetings with the Glassware Guild and with the National Lighting Fixture Dealers' Society, which will meet in Detroit during the same week. Among the topics to be discussed will be cost accounting, design protection and standardization. A luncheon with interesting talks will be given each day and the banquet will be given on Thursday evening.

During the entire week of these meetings there will be held a special exhibition to be called the Chandelier Show and Fixture Market. Each afternoon is especially reserved for this purpose. Wednesday evening will be set apart as architects' and builders' night and Friday evening as public night. This show, as well as all the meetings referred to, will be held at the Hotel Statler, Detroit, Mich. Fred R. Farmer, president of the Beardslee Chandelier Manufacturing Co., 216 South Jefferson street, Chicago, is president of the National Council of Lighting Fixture Manufacturers.

UNDERWRITERS' LABORATORIES ISSUE APPROVAL OF RENEWABLE FUSES.

Performance Records and Tests Show that Certain Fuses of Renewable Type Are Considered Standard and Satisfactory for Installations.

Removal of much of the opposition that has existed in regard to renewable fuses is indicated by the issuance of approval cards by the Underwriters' Laboratories this week covering renewable fuses manufactured by several different companies.

Following extended controversy on the subject of approval, the matter was referred to the Bureau of Standards in 1915 and the Bureau, in the capacity of arbitrator, decided that while renewable fuses appeared to be satisfactory, further performance records and tests were necessary before formal approval should be made. Specifications for standard renewable fuses were drawn by by the Underwriters' Laboratories and were issued last July after being approved by the Fuse Section of the Associated Manufacturers of Electrical Supplies and the Electrical Council of the Underwriters' Laboratories. Samples were submitted for test by the different manufacturers and such tests have resulted so far in the approval of the following:

Chicago Fuse & Manufacturing Co., Chicago. "Union," 0-600 amperes, 250 volts.

Economy Fuse & Manufacturing Co., Chicago. "Economy," 0-600 amperes, 250 volts; 0-600 amperes, 600 volts.

Federal Electric Co., Chicago. "National," 0-400 amperes, 250 volts; 0-100 amperes, 600 volts.

Trico Fuse & Manufacturing Co., Milwaukee. "Trico," 0-600 amperes, 250 volts; 0-600 amperes, 600 volts.

Samples from a number of other manufacturers are in process of test at the Underwriters' Laboratories and approval cards will be issued as soon as they are found to meet the test specifications.

This action by the Underwriters' Laboratories means that inspectors will be at liberty to pass renewable fuses and that the Electrical Committee of the National Fire Protection Association, which will meet next March for the purpose of revising the National Electrical Code, will undoubtedly revise the rules relating to fuses as a technical indorsement of the action of the Underwriters' Laboratories.

SALE OF ELECTRIC GENERATOR SETS BY WAR DEPARTMENT.

Surplus Stock of 25-kw., D-c., Gasoline Engine-Driven Sets to Be Sold.

The War Department authorizes publication of the following statement:

The director of sales announces that the Surplus Property Division, office of the quartermaster general of the Army, is offering for sale 400 gasoline-driven, electric generator sets, complete with switchboards and gasoline tanks, which have been declared surplus by the War Department and on which offers will be received at any time by the Surplus Property Division, Munitions building, Washington, D. C.

The generator is a 25-kw., direct-current, commutating-pole type. Either 115-volt, two-wire, or 230-volt, three-wire, generators can be supplied. The engine is of the closed, four-cycle, single-acting, vertical type, with four cylinders and is capable of operating the generator at full load indefinitely and at a 25% overload for two hours. The sets are high grade in every respect and combine a number of improved safety and gasoline-saving features.

These machines are designed for close regulation which makes them very desirable for small electric light and power plants, such as are required by rural stores and hotels, isolated small factories and even small towns. Owing to the continued coal shortage, these gasoline-driven generators should prove particularly useful as auxiliary or emergency lighting and power equipments in many cases.

The sets which the Government is offering for sale

are new and have been carefully stored since they were purchased by the Government about a year ago. They are packed in the crates in which they were shipped from the factory. They are located at Schenectady, N. Y., and New Cumberland, Pa., and will be shipped promptly upon approval of submitted offers.

Inspection of the machines, switchboards and tanks may be made at the points of storage or complete specifications may be obtained from the Surplus Property Division, Munitions building, Washington, D. C. Information relative to the terms of sale, storage points, etc., may be obtained from the same office.

IMPORTANT COMMITTEE MEETINGS OF N. E. L. A.

Public Policy and Executive Committees to Hold Meetings with Full Attendance in January—Important Measures to Be Discussed.

Important meetings at which the enlarged program for the future activities of the National Electric Light Association is to be discussed will be held in New York City in January.

A meeting of the Public Policy Committee will be held at the headquarters in the Engineering Societies Building on Jan. 29. John A. Britton, chairman of the committee, will come from San Francisco to preside. President R. H. Ballard, of Los Angeles, will also be present. It is expected that the full membership of the committee will be present. Suggestions and advice will be requested from the committee in regard to the future activities of the association and the new program which is now being arranged.

The Executive Committee meeting will be held on Jan. 30. Action will be taken on the program for future activities and an effort will be made to settle definitely the matter of the geographic sections. In speaking of the progress which is being made in the organization of the central stations of the country into geographic section affiliation with the National Electric Light Association, M. H. Aylesworth, executive assistant to the president, said: "The outlook is very encouraging. The plan is receiving widespread favorable comment and many state organizations have shown a desire to aid in carrying it through."

COMMITTEES OF NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION.

President Fisken Appoints Leaders of Central-Station Industry of Northwest States to Conduct Committee Work Actively.

The Executive Committee of the Northwest Electric Light and Power Association met at Portland, Ore., on Nov. 26, to mature plans for proper representation of the association at the National Electric Light Association's national convention to be held in Pasadena, Cal., next May. Another phase of the meeting was the decision to have an advisory committee to evolve a plan of co-operation among power companies, contractor-dealers, jobbers and manufacturers, and to report to the Executive Committee. It is proposed to define the work of the new sections, comprising accounting, commercial, public relations, hydroelectric and technical, and membership, for all of which the president of the association will appoint a governing committee.

The Public Policy Committee of the association, whose duties are highly important, is made up of following members appointed by President John B. Fisken: Franklin T. Griffith, president of Portland Railway, Light & Power Co., chairman; Guy W. Talbot, Portland, president Pacific Power & Light Co.; Guy C. Pierce, vice-president and general manager Northwestern Electric Co., Portland; A. W. Leonard, president Puget Sound Traction, Light & Power Co., Seattle; D. H. Huntington, president Washington Water Power Co., Spokane; F. M. Kerr, general manager Montana Power Co., Butte; W. R. Putnam, vice-president and general manager Idaho Power Co., Boise; F. T. Johnson, president Idaho Power Co., Boise; Geo. L. Myers, assistant to president of Pacific Power & Light Co., Portland; F. D. Nims, vice-president and general manager of Washington Coast Utilities, Seattle. There is also a separate public policy committee for each of the states of Oregon, Washington, Idaho and Montana.

A special effort is to be made for enlarging the membership of the association by the following Membership Committee:

Geo. L. Myers, of Pacific Power & Light Co., Portland, chairman; A. S. Moody, of General Electric Co., Portland; F. D. Nims, Washington Coast Utilities, Seattle; J. F. Farquhar, Washington Water Power Co., Spokane; J. I. Colwell, Western Electric Co., Seattle; J. F. Orr, Idaho Power Co., Payette, Idaho; T. W. Neill, Kootenai Power Co., Coeur d'Alene, Idaho; R. J. Coban, Westinghouse Electric & Manufacturing Co., Butte, Mont.

ELECTRICAL EXPORTS FOR OCTOBER UP TO AVERAGE OF YEAR.

Nearly 50% Increase in Value of Shipments Compared with October of Last Year.

Although below the record monthly total of last June, the electrical exports of the United States during last October were nearly equal to the average monthly figure of the preceding months of this calendar year. They exceeded the total value of the electrical shipment of October, 1918, by nearly 50%.

The classified figures for last October and for the corresponding month of 1918, as extracted from the monthly summary of the foreign commerce of the United States, just issued by the Bureau of Foreign and Domestic Commerce, Washington, D. C., are given in the following table:

Articles.	October— 1919.	1918.
Batteries	$ 507,704	$ 276,730
Carbons	121,621	114,991
Dynamos or generators	452,946	254,156
Fans	79,406	15,679
Heating and cooking apparatus	164,114	86,144
Insulated wire and cables	487,444	525,031
Interior wiring supplies, including fixtures	168,902	83,656
Lamps—		
Arc	2,239	273
Carbon filament	6,075	5,758
Metal filament	334,835	191,344
Magnetos, spark plugs, etc	222,972	222,095
Meters and measuring instruments	237,077	83,674
Motors	1,007,930	1,147,159
Rheostats and controllers	63,153	30,281
Switches and accessories	347,152	124,720
Telegraph apparatus, including wireless	44,566	19,689
Telephones	388,428	148,312
Transformers	218,789	206,575
All other	2,425,310	1,324,313
Total	$7,280,663	$4,860,584

The above figures do not include electric locomotives, of which there were exported last October 13 engines valued at $51,130.

For the ten months ended Oct. 31 last, the total

value of electrical exports, excepting locomotives, was $75,719,867, compared with $48,618,300 for the corresponding months of 1918, and with $44,130,615 for the similar months of 1917.

VACUUM CLEANER MANUFACTURERS' ASSOCIATION ORGANIZED.

Charles S. Beardsley, of the United Electric Co., Made Chairman of the Association.

An interesting meeting of vacuum cleaner manufacturers was held at Cleveland, Ohio, on Dec. 5. All the vacuum cleaner manufacturers in the United States were represented and the Vacuum Cleaner Manufacturers' Association was formed for the betterment of the vacuum cleaner industry which it is believed will be of decided benefit to the trade in this useful appliance.

Officers for the coming year were chosen at this meeting and Charles S. Beardsley, general manager of The United Electric Co., Canton, Ohio, was unanimously elected chairman of the association. A. J. Stecker, president of the Stecker Electric Co., Detroit, Mich., was made vice-chairman, and C. G. Frantz, general manager of the Apex Electrical Manufacturing Co., Cleveland, Ohio, was chosen secretary and treasurer.

An executive committee was appointed consisting of F. S. Hunting, general manager of the General Electric Co., at Ft. Wayne, Ind.; H. W. Hoover, general manager of the Hoover Suction Sweeper Co., North Canton, Ohio; and A. S. Phillips, of the Spencer Turbine Cleaner Co., Hartford, Conn.

ELECTRICAL CONSTRUCTION PROJECTS INCREASING.

Indications Show Increase in Building of Power Plants to Supply Demands for Electrical Energy.

That electrical construction activities are being increased is indicated by a statement recently made by G. O. Muhfeld, general director of Stone & Webster Engineering Corp., in which he said that probably never in the company's experience has so great a volume of electrical construction projects been impending at any one time. The situation is accepted as reflecting the confidence of business generally in the favorable trade outlook of the immediate future.

Among new contracts lately taken by Stone & Webster is one for the design and construction of a 20,000-kw. steam-driven electric power plant for the New Bedford Gas & Electric Co. at New Bedford, Mass. This development is in the eastern textile territory and is required to meet the growing power demands of that expanding industry. A contract for the design and construction of a 12,000-kw. steam-driven electric power plant for the Pittsburgh Plate Glass Co. is another of the new projects. This unit will be erected at Kokomo, Ind.

MAINTENANCE OF LIGHTING EQUIPMENT DISCUSSED IN CHICAGO.

Symposium on Maintenance Held by the Chicago Section of the Illuminating Engineering Society.

The importance of maintenance of lighting equipment and dependable methods of insuring proper maintenance formed the general topic of a symposium of short papers and talks before the Chicago Section, Illuminating Engineering Society, held on the evening of Dec. 18.

J. L. Stair, chief engineer, National X-Ray Reflector Co., opened the series by describing the national and local maintenance campaigns conducted by that company in the effort to get owners of its lighting installations to adopt regular cleaning schedules. A card system was developed for reminding of the need for cleaning. In Chicago a window-cleaning company was induced to organize a fixture-cleaning department that was later established as a separate company. It makes maintenance contracts, including periodic cleaning of fixtures (usually monthly), lamp renewal and replacement of broken reflectors and fixture parts. The average charge has been about 21 cents per fixture per month. This service has proven very satisfactory for offices, stores, shops, etc.

F. A. Kaup, supervisor of the service and repair department, Commonwealth Edison Co., described the maintenance service of this large central-station company, which takes care of the lighting maintenance of some 25,000 customers using rental fixtures. The organization that renders this service is quite a large one, consisting of cleaners, patrolmen, foremen and supervisors, besides many clerks and telephone operators at headquarters. The work is very systematically carried out, the men keeping in touch with the office hourly by telephone for emergency orders. Not only is the cleaning done at fairly regular intervals, but lamp and fuse renewals are made at very short notice. Among the fixtures looked after are store and factory fixtures, store-window lighting, signs and ornamental street posts. Trucks and wagons are commonly used for carrying ladders, extra lamps, globes, cleaning equipment, etc. Numerous difficulties are experienced in getting at fixtures in some factories. The experience has been that, unless such maintenance service is furnished by a specially organized crew, the customer quickly neglects his lighting equipment and then complaints become frequent and vociferous.

Henry Nixon, deputy commissioner of gas and electricity of the City of Chicago, explained the methods used by the city in maintaining its street-lighting system of some 46,000 series incandescent lamps. Patrolling is done every night on every circuit in the city and on lamps that can be lowered an effort is made to renew burnouts immediately, the patrolmen carrying a stock of lamps on their automobiles. In other cases the lamps are renewed during the following day, the remaining time of the trimmer being devoted to cleaning. On business streets the cleaning is done more frequently than on residence streets. Some difficulty has been met with the class of labor that the city has been compelled to employ, which makes the maintenance service more expensive and less reliable than it should be. All lamps are tested as received from the factory and defectives immediately rejected. With the special lamps now used the average life runs from 2200 to 3000 hours. Experiments with a sealed fixture show that the lamp temperature is not seriously affected while the dirt getting into the fixture is very much reduced, so that a higher state of cleanliness is maintained.

C. H. Shepherd, electrical engineer, Lincoln Park Commissioners, described the system of maintaining park and boulevard lamps of the Lincoln Park system. The lamps in buildings are attended to about once a week on the average, while outdoor lamps are cleaned regularly about once each fortnight. Trouble is met in cleaning the globes on lamps along the lake shore of sand flies and other insects during the summer, scour-

ing the globe with sand being often necessary. A tower wagon or truck is used; it has a compressed-air tank for blowing out the inside of the globe, compensator, free from dust and insects. A 20-in. opal globe is used on all outdoor posts; at first there was considerable breakage of these globes till the men became skilled in handling them on top of the post. Mr. Shepherd also explained the lamp record system he described in the last issue of the ELECTRICAL REVIEW.

E. D. Tillson displayed a number of fixtures collected from various installations and showing typical instances of neglected maintenance. He also showed an ingenious type of self-cleaning fixture for foundries and other dusty places; it has a wiper that cleans off the plate-glass bottom of the fixture every time it is turned on or off. A. L. Arenberg showed a fixture that is easily cleaned by means of a feather duster. Others joining in the general discussion were J. R. Cravath, F. A. Kaup, A. C. King, J. L. Stair, F. H. Bernhard and Messrs. Lucas and Curtis.

INDUSTRIAL SAFETY CONFERENCE HELD AT BUREAU OF STANDARDS.

Condensed Report of Meeting at Washington, Dec. 8—Joint Committee on Safety Codes to Be Organized.

In the absence from Washington of the director of the Bureau, Dr. S. W. Stratton, the meeting was called to order by Dr. E. B. Rosa, who summarized at some length the events leading up to this conference and referred especially to the proceedings of the similar conference held on Jan. 15, of which this in a sense was an adjourned meeting. The discussion at that conference was summarized and reference made to its action for the appointment of a committee which has since made a printed report.

The principal subjects which came up at the January conference were the reorganization of the American Engineering Standards Committee and the question of whether the safety work of the Bureau of Standards should be conducted under the scheme of procedure laid down by that committee.

The last question was the subject of a letter ballot on Plans "A" and "B" sent out in the spring, the result of which was a decided majority in favor of procedure under the plan of the American Engineering Standards Committee. This committee has adopted since the January conference a revised constitution which opens its membership to other organizations in addition to the original five founder societies and three government departments.

Dr. Rosa also announced the appointment of a General Advisory Committee on Industrial Safety Codes for the purpose of assisting the Bureau of Standards in deciding upon policies and procedure in its work on safety codes. He said: "The Advisory Committee recently appointed by the Bureau is not the Managing Committee proposed under Plan A. It is for the present merely an advisory committee for the Bureau of Standards. After this conference is ended that committee will meet and deliberate. If this conference wishes to make any recommendation on request to that committee it can do so, or if it wishes to adopt it as a committee of this conference it can do so. Or this conference can have a different committee if it prefers, or can appoint some additional members to sit with or become a part of the Bureau's committee. We want this conference to feel entirely free to discuss the important question submitted without hindrance or restriction of any kind."

Prof. Comfort A. Adams, chairman of the American Engineering Standards Committee, then spoke on the work of that committee and its recent reorganization. Membership in that committee is now open to such organizations or groups of organizations of national scope as may be approved; there shall be no more than three members from each such organization, and the annual dues are $500 for each representative. Applications for membership must set forth the scope of their standardization interests and activities and the number of members. If such application is approved by three-fourths of the committee it is submitted to the organizations having membership on the committee, and unless disapproved by more than one-fourth of these within 90 days, it is considered to be ratified. The speaker stated that he would be superseded as chairman of the committee by A. A. Stevenson, and that the permanent secretary of the committee will be Dr. P. G. Agnew, at present in the Bureau of Standards. The headquarters of the committee will be in New York City.

The procedure to be followed in the development and adoption of American engineering standards was then outlined. Committees to formulate standards shall be organized by suitable engineering societies, government bureaus or other bodies which shall be designated as sponsors and shall be responsible for the carrying out of the work. Such a committee must include representatives of all interests concerned in the formulation of a standard, and upon completion of its work and substantial agreement upon the same, shall report to the sponsor body. If the latter adopts the standard it is forwarded to the American Engineering Standards Committee for approval, and when so approved, shall be designated as either recommended practice, tentative standard, or American standard. The Standards Committee will not itself pass judgment upon the details of the proposed standards but rather upon the composition of the committee which has formulated the standard or approved it. This committee must not be confined to the membership of the sponsor body, but must include representatives of all interests concerned in the standard.

A number of other organizations have already applied to the American Engineering Standards Committee for membership. These include the National Safety Council, American Mining Congress, insurance, utility and technical associations. To become a member an organization must be national in its scope. Thus individual state industrial commissions would not be considered eligible, but as a group they might join through their national association.

The status of industrial safety codes now existing was next discussed by Dr. M. G. Lloyd of the Bureau of Standards, Dr. L. W. Chaney of the Bureau of Labor Statistics, S. D. Collette of the American Society of Mechanical Engineers and W. S. Paine of the Aetna Life Insurance Co. Dr. Lloyd exhibited a number of charts on which it was attempted to show the scope of existing safety rules in the industrial field but exclusive of the subjects of transportation, mining and industrial hygiene. The relation of fire prevention to human safety was considered and a distinction drawn between rules for fire prevention of property and accident prevention to individuals. The regulations considered included those of state laws, commission orders, city ordinances and the rules prepared by insurance organizations, technical societies and manufacturers' organizations as well as Federal Government bureaus, the National Safety Council,

etc. A knowledge of such existing rules was considered essential to the intelligent development and revision of safety regulations.

Dr. Chaney pointed out that a survey of accident records would show what hazards are greatest and consequently what industries are most in need of safety regulations. The method of administration of safety rules is of more importance than the contents of the rules themselves and good results depend upon general co-operation and efficient administration. Compensation laws have brought about an improvement in accident prevention work.

Mr. Collette referred particularly to the Boiler Code of the American Society of Mechanical Engineers and the recent work of that society in preparing an Elevator Code in co-operation with the Bureau of Standards.

Mr. Paine referred to the disadvantages of nonuniformity of temporary rules and said that to have a satisfactory code it was necessary to have the cooperation of all interested. The insurance companies had done a great deal to promote universal standards, especially through the medium of their rating bureaus and were in a position to introduce rules and apply them before they were made mandatory by law.

The symposium on Methods and Policies to Be Pursued in the Development and Introduction into Use of Safety Standards was participated in by S. J. Williams of the National Safety Council, O. B. Connelley of the Department of Labor and Industry of Pennsylvania, C. M. Talbert, director of the Department of Streets and Sewers, St. Louis, W. C. L. Eglin of the National Electric Light Association, A. C. Morrison of the International Acetylene Association, A. Rousseau of the Abrasive Wheel Manufacturers' Association, Henry Sterling of the American Federation of Labor, and Lew R. Palmer of the Equitable Life Insurance Co.

Chester C. Rausch of the Safety Institute of America introduced the following resolution which was adopted by the conference:

"Resolved: (1) That the American Engineering Standards Committee be asked to request the International Association of Industrial Accident Boards and Commissions, the Bureau of Standards and the National Safety Council to organize a Joint Committee on Safety Codes, this committee to include representatives of these bodies and such others as they may consider advisable; (2) that this Joint Committee report upon the safety codes required, priority of consideration of the codes, and sponsor bodies for their preparation; (3) that this report be put in writing and placed not later than Feb. 1, 1920, in the hands of the American Engineering Standards Committee."

Before taking the vote on this, however, another motion was passed confirming the result of the letter ballot taken last spring and expressing the decision of the conference that safety codes should be established under the procedure of the American Engineering Standards Committee.

In the discussion on this subject it was pointed out that the American Engineering Standards Committee was not primarily interested in safety matters and that the committee contemplated in the resolution of Mr. Rausch would be directly concerned in such matters and might well serve as a steering committee on safety-code work. The opinion was freely expressed that such a committee should be a permanent one, that it should contain representatives of all interests involved in safety codes and that it might well be called a National Safety Code Conference and hold annual meetings. Such a committee would be in position to co-ordinate work on safety codes, to arrange for necessary interpretations, to initiate new codes as they become necessary, and to form a central agency to insure co-operation.

At a meeting of the General Advisory Committee of the Bureau on the following day, the work of the proposed committee which the American Engineering Standards Committee has been asked to appoint was further discussed and the opinion was generally expressed that such a committee, if made a permanent organization, would render the General Advisory Committee of the Bureau of Standards unnecessary. There was also a discussion of means for introducing codes and for securing interpretations of rules in particular cases as the necessity for the same might arise. Before adjournment a motion was passed giving the Bureau of Standards a vote of thanks for taking the lead in calling these conferences and bringing the matter of engineering and safety standards to the attention of all concerned.

LECTURE ON FUNDAMENTALS OF ECONOMICS BEFORE LYNN SECTION.

Before the Lynn (Mass.) Section of the American Institute of Electrical Engineers, on Dec. 17, George E. Roberts, of the National City Bank of New York, gave a closely reasoned address on "The Fundamentals of Economics." He paid a glowing tribute to the work of the engineer who has been at his task and calling all the time for the most efficient means of investing capital in machinery and thereby adding to the general good. Capital is really physical equipment for the increase of production. Distinction was drawn between the two kinds of wealth, consumable and nonconsumable, the latter being that most useful kind of capital that is not hoarded but is put back into productive business.

About 250 attended the lecture and at its close Richard H. Rice, acting manager of the Lynn works of the General Electric Co., spoke briefly. On Jan. 7 there will be a lecture on the manufacture of steel.

SPECTACULAR ILLUMINATION PLANNED FOR ELKS' CONVENTION.

Arrangements are already being made on a big scale for the convention of the Grand Lodge of the Order of Elks which will be held in Chicago on July 5 to 10, 1920. Among the attractions for this big national gathering will be special electrical displays that will center in Grant Park on the lake front where the largest elk's head ever built will be erected and encrusted with thousands of colored lights. From this point the chain of lighting will extend to every part of the city, with special features for the Municipal Pier, the principal parks and other entertainment centers.

UNIVERSITY OF ILLINOIS TO HOLD ELECTRICAL SHOW.

The department of electrical engineering at the University of Illinois is making plans for an electrical show to be held April 8-10. Several large and successful expositions have been held at the university in the past, but they were discontinued during the war period. Tentative plans for the 1920 show indicate that it will be larger and more elaborate than those of preceding years.

Commercial Practice

Making Extensions in Rural Communities — Factors Affecting Electric Furnaces—Moving Poles from Streets

EXTENSIONS OF ELECTRIC SERVICE TO RURAL CUSTOMERS.

An Outline of Practice in Illinois Regarding Rural Service, Presented in Paper Read Before the Illinois State Electric Association.

By D. W. Snyder.

General Superintendent, Bloomington & Normal Railway & Light Co.

The exceptional prosperity of the farmers during the last few years has created a demand upon central stations for rural service, which few, if any, were prepared to meet. The result has been that an immense mileage of low-voltage rural transmission lines has been built, with little attention paid to standardization in construction, method of ownership, or to a scientific system of rate making. The continued activity in rural business, however, has awakened the Illinois Public Utilities Commission and most of the central-station managements in the state to the fact that rural business is not a negligible factor and presents some costly and intricate problems.

A number of small central stations which have allowed rural lines to be attached to their systems have discovered too late that these customers are unprofitable and quite troublesome, with the result that they are disgusted with the business and opposed to any more additions. This hostile attitude is natural, but the rural business must be served and can be developed in much the same way that the small central stations developed day service. Necessarily, there will be some initial disappointment, but with proper methods the business can be handled and at a profit.

The usual rural single-phase line is of 2300 or 6600 volts, 30-ft. cedar poles, 6 or 7-in. tops spaced 35 to 40 to the mile, with wooden cross-arms and insulator pins. No. 6 hard-drawn copper wire is used and the line built under the Commission's standard rules. A line of the above type can be built from $500 to $800 per mile and will meet the requirements of 90% of the rural business.

A quite satisfactory method of financing such a line to serve a small group of farmers is to build the line proper and divide its cost equally among the farmers and then charge each farmer in addition for the equipment, such as transformers, etc., necessary to his individual use.

The line and equipment should be maintained by the utility but the cost borne by the farmers, who retain ownership. A contract for maintenance preferably should be between the company and a responsible trustee or a committee for the farmers and must provide for proper inspection and maintenance at a cost based on material and labor. In case of the farmers failing to meet their obligations under the contract, the company should have the right, by reasonable notice, to terminate the agreement and the service. This arrangement would come under the second section of the Commission's order No. 59 and insures a line that will be kept in good operating condition.

Under this plan the only problem presented to the utility is to give adequate service at a proper rate. It has been demonstrated that such a line as has been described, equipped with lightning arrestors on each transformer, will provide good service when proper size service wires and transformer are installed, so the only remaining factor is the rate.

In the matter of rates, practically all of the companies operating in Illinois have either failed to file a rural rate or have applied their regular lighting schedule with a slightly higher minimum; in the majority of cases a $2 minimum is required. This use of established urban rates to rural customers is the reason most central stations are opposed to taking on the business.

The average farm customer not using electric power will require a 1-kw. transformer, which, in most cases, serves no other customer. The core losses on a 2300-volt 1-kw. transformer for one month will average 14 kw-hrs. Average consumption of a number of farmers, each served by a 1-kw. transformer, showed 19 kw-hrs., which, at 15 cents per kw-hr., made a gross income of $2.85 per customer. Adding the core losses to the consumption, a resultant income of 8.5 cents per kw-hr. is obtained. This rate will invariably be less than that charged for adjacent urban service, where, because of the diversity factor of a large number of customers on each transformer, the core losses are practically negligible per customer.

In the case of a small power customer, a 3-kw. transformer is usually required. The core loss will be about 23 kw-hrs. per month. An average of customers so equipped was 20 kw-hrs. per month, making a gross bill, at 15 cents per kw-hr., of $3 per month and an average return of slightly less than 7 cents per kw-hr. when the core losses are added.

The above data shows that the application of city rates with slightly higher minimum to rural service is economically unsound. The remedy is a primary charge sufficient to cover transformer core losses at a low rate plus city rates for the actual energy used. This form of rate has only one objection and that is the difficulty of making the farm customer see that the service to him is different than city service and that a charge for transformer core losses is a proper one. The Illinois Public Utilities Commission probably would approve such a rate, for in commenting on the application of the Central Illinois Public Service Co. to place certain farm-lighting customers on its standard farm rate, it said: "It would be perfectly feasible and legal to file a schedule of rates applicable to farm houses only and then if there are any industries in the locality the service to them would not come under that rate." The Central Illinois Light Co. placed in effect last August a schedule of rural rates, rules and regulations similar to the plan outlined

above, but omits the primary charge covering core losses.

The Illinois Public Utilities Commission, under its general order No. 59, ordered: "If the proposed rural customers contemplate receiving service as individuals, the arrangements as to the construction and ownership of the necessary lines must be such that the title of the said lines when completed will rest in the electric public utility and that the electric public utility will be responsible for their maintenance, and it must be agreed that any other consumer along the route of the said lines will receive service, if applying for same, upon a nondiscriminatory basis."

This provision, if used by any utility serving customers at its regular rural rates, would create a condition of discrimination against the customers owning and maintaining their own lines, unless the Commission will allow a maintenance contract to be made with the individual, as is the case previously cited.

In the event of the utility accepting the gift of a half mile of line, and being obliged to maintain same, the following would be a fair representation on usual rural rate:

First cost one-half mile of line	$300.00	
3-kw. transformer and lightning protection	60.00	
Meter, service, etc	40.00	
Total	$400.00	
Maintenance and depreciation, estimated at 10%		$40.00
Core losses at 4 cents per kw-hr		11.05
Meter reading, billing, testing, etc., estimated		6.00
Energy, 21 kw-hrs. at 6 cents per kw-hr		12.60
Total annual cost		$69.64
Annual revenue at 15-cent rate, $1.00 min		$37.80
Anual loss per customer		$31.84

The above revenue figures are actual averages from 3-kw. rural installations in a wealthy farming section of the grain raising district. This shows conclusively that even under ordinary operating conditions this type of business does not pay.

The practice of taking over and maintaining rural lines will lead to disastrous results, and immediate steps should be taken by all the operators to correct the present tendency of letting this important matter drift. The farms will never use sufficient energy to make the business remunerative unless they are made to pay for maintenance cost and core losses.

The first section of the Commission's order No. 59 reads as follows: "If the prospective rural consumers have formed a corporation for the purpose of constructing the said lines and receiving the said service, and propose to render such service to all applicants along the routes of the said lines, this corporation shall secure a certificate of convenience and necessity and file rates with the Commission, as requird by law. Any electric public utility shall refuse to connect its circuits with the circuits of such a corporation until these requirements of the law have been complied with."

This has been found to be the most satisfactory method of handling larger groups of rural service. The practice is to sell them their requirements on a kilowatt-of-demand rate and an energy charge. This, of course, places the responsibility on the rural utility, but as they usually are co-operative in that each customer owns stock, the burden falls where it belongs. Following is the rate used: $3 per month per kw. of demand for first 10 kw.; $1.50 per month per kw. of demand for all over 10 kw. The energy charge is as follows: For first 500 kw-hrs. used in any month, .04½ per kw-hr.; for next 2000 kw-hrs. used in same month, .03 per kw-hr.; for all over 2500 kw-hrs. used in same month, .017 per kw-hr. A discount of 10% for payment by the tenth of month is allowed on all bills. The resultant rate per kw-hr. at the substation switchboard has been $0.061 per kw-hr., with a load-factor of 16%.

This rate has been given to two groups of rural customers, each one comprising a small town in connection with 10 miles of 6600 and 2300-volt lines.

The widespread use of farm-lighting systems show that farmers want and are willing to pay for electric service. These systems are costly both in first cost and maintenance and are at best a substitute for central-station service. If the farmer will invest $500 to $1500 in a private lighting system and pay the high maintenance cost they should not object to contracting for their share of a line to serve them and pay an equitable rate based on actual cost of service. It is general opinion that farmers are willing to do anything that is right, and the exception is the fellow who would make the undesirable customer anyway.

The rural business is too experimental to give much concrete information concerning it. Points needing emphasis are that central stations should recognize the fact that rural communities are demanding service and their demands must be met, that one or two standard plans of rendering service must be adopted, and that the present system of rates must be corrected.

FREQUENCY FOR AND CAPACITY OF ELECTRIC FURNACES.

Twenty-five and 60 cycles are both being used for electric furnace supply. The use of 25 cycles permits of a greater power input to a given furnace than does the use of 60-cycle energy, due to the lower magnetic losses and decreased heating and inductive effects of the higher periodicity. A very much better power-factor exists with 25-cycle energy than with 60 cycles, for the same reasons, and these same factors apply to the maximum power input feasible.

At the present time the largest electric furnace operating on 60-cycle supply is rated at 15 tons of steel. Experience has shown that a furnace for melting steel can take a molten charge of about 30 tons and will require from 2000 to 2500 kw. to handle this amount of metal satisfactorily. Such a furnace can be operated from a 60-cycle supply at 60 cycles. For a three-electrode furnace about 3000 kv-a. probably represents about the limit as imposed by economy. A furnace of this size, handling molten metal, should be capable of producing from four to five thousand tons of steel per month, with an input varying between 2000 and 2500 kw.

CO-OPERATION BETWEEN UTILITIES RIDS STREETS OF POLE LINES.

The Southern California Edison Co. and the Southern Sierras Power Co. were ordered by the city council of San Bernardino to remove their pole lines from certain of the streets within the city. The two utilities got together and by mutual agreement decided to move their respective lines, one north and the other south from the street to the alley. In this way all poles and wires were removed from the main thoroughfare and services have been made at the rear of buildings. By co-operation and reciprocity the two power companies were able to save themselves time and money and bring about a pleasing conclusion to the city's demand.

Operating Practice

Hydraulic Turbine Bushings — Power-Factor Correction —Operation of Thrust Bearings — Exhaust Steam Heat

ELECTRIC HEATER FOR BRONZE AND STEEL BUSHINGS.

Method of Simplifying Installing Bushings on Hydraulic Turbine Shafts.

By R. H. Pickens.

Southern Public Utilities Co.

In installing new bronze and steel bushings, on the shafts of vertical waterwheels, some method of heating them in order that they be expanded enough to allow of their being forced to their seats upon the shafts, was found necessary. After some experimenting it was decided that some form of electric heater would be most satisfactory.

The bushings fit on the lower part of the shaft, above the turbine rotor, and serve the purpose of preventing wear on the shaft proper, where it passes through the turbine guide bearing; these bearings being of the conventional *lignum-vitae* block type of underwater bearing. The original bushings were of bronze, and it was found necessary to heat them to about 300 deg. F. in order that they might be forced upon their seats with the equipment on hand.

The bushing was first wrapped with one layer of a heavy smooth wrapping paper, put on tightly and without wrinkles. The heating element consisted of a single layer of No. 18 B. & S. black iron wire, spaced about ¼ in. between turns and wrapped tightly over the paper; no heat insulating material was used over the wire as experience showed this to be unnecessary. Fig. 1 shows the bushing in place and the connections as made when heating it.

To heat the bushing, current was taken from the exciter circuit of the plant at a voltage of 125 volts. The field leads of the alternator being disconnected from the brush holder studs, and No. 4 copper wire connected to the leads, was dropped into the wheel pit, where connection was made to the heater; field switch and rheostat of the alternator controlled the

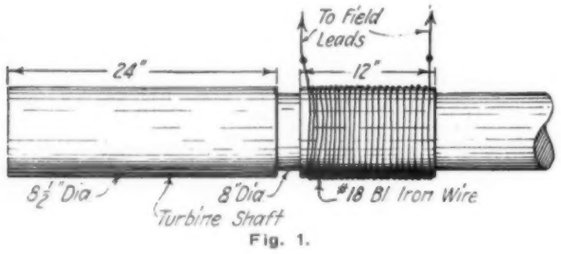


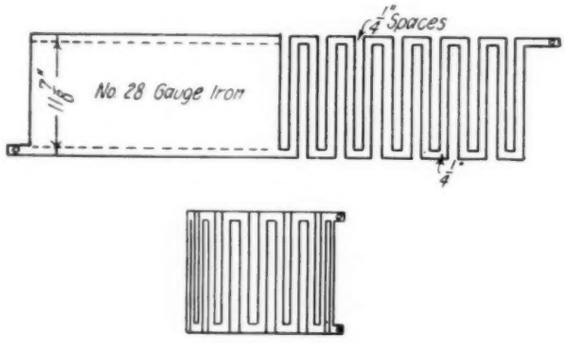
Fig. 1.

current. A current of about 60 amperes was found sufficient to expand the bushing enough to allow its being forced upon the shaft with a press made of two small screw jacks.

After experience had shown that a bushing made of cast-iron or steel gave superior service and a longer life on these underwater bearings, it was decided to install bushings made of manganese steel.

The bronze bushings were ⅜ in. in thickness and in 12-in. sections, the steel bushings were of manganese steel, without temper and in sections of the same length as the bronze ones.

In installing the steel bushings it was found that the method used in expanding the bronze was not effective, so a different type of heating element was designed. This heater was made of No. 28 gage



Figs. 2 and 3.

black iron sheet 11⅞ ins. wide and of such length as to encircle the bushing, this sheeting being cut into the form shown in Fig. 2.

Brown wrapping paper was used as the insulator between the metal and the heater as was used on the bronze bushings, the heater being placed on the bushing as in Fig. 3.

A heat insulator of sheet asbestos was placed around the outside of the bushing, covering the heating elements, and a few turns of iron wire were wrapped over the asbestos jacket in order to bind the heating element firmly against the bushing. This later type of heater proved rapid and effective in service, being superior to the original form of wire wound heater. It required about 20 minutes in each case to raise the temperature of the bushings to the proper expansion point to allow their being forced upon their seats, with the home-made press that was used.

TWO 4000-KV-A. 13,200-VOLT CONDENSERS CORRECT POWER-FACTOR.

Power-Factor Raised from 76.4 to 86% and Improved Voltage Regulation Major Advantages.

The Hydro-Electric Power Commission of Ontario is operating two 4000-kv-a., 13,200-volt synchronous condensers at its Toronto Terminal station for the express purpose of bringing up the power-factor and improving voltage regulation. Each machine obtains its excitation from its individual exciter, which is belt driven. The condensers are connected to the

13,200-volt bus, which in turn receives its energy from the incoming 110,000-volt lines through transformers. It has been found that the total kilowatt capacity of the station has been increased 12% by the use of these two synchronous condensers.

The following data was obtained during special tests soon after the machines were installed and indicate the power-factor can be raised from 76.4 to 86%, representing a reduction in wattless current of 21%, which not only increases the capacity of the transformers in the Toronto substation but likewise reduces the line loss and thereby extends the line capacity of the transmission lines and the generating capacity at the other end of the line. Voltage regulation is correspondingly improved.

	Condensers both off.	One condenser operating.	Both condensers operating.
Input to consumers, kw.....	0	310.0	619.5
Input to condensers, kv-a.....	0	3450.0	7052.0
Total excitation in kw.....	0	39.41	76.15
Power-factor Toronto station load (lag)	76.4%	81.0%	86.0 %
Power-factor of total hydro load measured at Niagara.	84.9%	85.4%	88.6 %
Power-factor of condenser bus		9.0%	8.78%
Watless factor, Toronto station load	64.5%	58.5%	51.0 %

DATA UPON KINGSBURY THRUST BEARING OPERATION.

Hydraulic Turbine Characteristics, Lubrication and Bearing Loads and Friction.

The Kingsbury bearing, invented by Albert Kingsbury about 1910, is largely used for the step and thrust bearings of hydraulic turbines, for steam turbines and also centrifugal pumps. The bearing in its simplest form consists of one or more pivoted segments or shoes against which the thrust collar presses as it rotates. The bearing faces are copiously supplied with oil so that perfect film lubrication takes place with its resultant low friction coefficient. That this type of bearing may be employed when the load carried is either great or small, the speeds high or low, and the oil heavy or light, is proved by some very complete tests, which are described in a paper presented by H. A. S. Howarth before the A. S. M. E. at the New York meeting held this month.

Tests were made upon various machines, including a steam turbine driving a large passenger steamer. However, central-station operating engineers are chiefly interested in the influence of the tests upon hydraulic turbine bearings and lubrication in general. Hydroelectric units ordinarily run on light engine oils and the film thicknesses are therefore much less at any speed and load than would be the case if heavy oils were used. They have to start and stop under practically full thrust load, consequently that service may be considered as the most severe for thrust bearings. When one of these units slows down it passes gradually through the whole range of speeds from normal to the very low speed at which the oil film breaks in the thrust bearing. All this time the friction coefficient, and hence the torque required to turn the rotor, is reducing. When the film breaks up the friction coefficient immediately increases and the rotor comes to rest.

Consideration of these severe service conditions suggests the following questions: At what surface speed does the film break? What happens to the bearing if it continues to turn after the film breaks? Does the film break suddenly? These questions are of great importance.

It is known that in a given bearing carrying a known load the film thickness at a given speed is greater for a heavy oil than for a light one. Hence a heavy oil will sustain a given load at a lower speed than will a light oil. It may be assumed that the oil film breaks when it gets so thin that the high spots begin to rub. If the bearing surfaces are poorly fitted the film will break at a higher speed than otherwise. When it is said that high spots rub on each other it is not meant that the metals come into contact with no oil between them. If the high spots are wet with oil, oil will persist in remaining between them. The local pressure may be enough to cause the softer of the two spots to be "ironed off" or crowded back out of the way. If the high spots are not of great magnitude the local heating will not be sufficient to make trouble and as soon as the high spots rub they will pass and cool. The softer high spot will recede on cooling and may even fall below the general surface. If the harder surface be perfectly flat it might iron off the soft high spots and make the soft face also flat. If the harder face is not perfectly flat the softer face will gradually conform to it as far as possible.

The results of the tests already carried out indicate that the lower the speed at which the Kingsbury bearing is run continuously, the better the condition of the bearing surfaces. Speeds as low as 0.38 r.p.m. have thus far been employed and further tests will be made with yet lower speeds. The range of pressures that may be employed extend from the initial test of 132 lbs. per sq. in. and a light oil to as high as 2000 lbs. per sq. in. with a light and a heavy oil.

INTERESTING METHOD OF HANDLING EXHAUST STEAM AND ELIMINATING CLOSED HEATER.

Excerpt from Paper Before Station Operating Meeting, Ohio Electric Light Association.

By W. H. Aldrich.

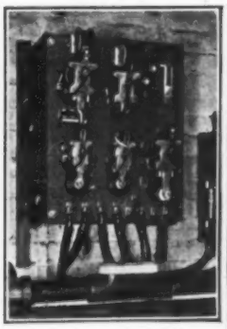
In the turbine room at the Lake Shore station of the Cleveland Electric Illuminating Co. is a system for handling the exhaust steam from the auxiliaries which I believe is rather unique. We have a separate but similar system for each turbo unit. The main feature of this system is a barometric condenser mounted above a large iron storage tank connected to the common feed pump suction header. The tank is the base of the barometric condenser tail pipe. All exhaust steam from the auxiliaries of that turbo unit are piped to this condenser, and the condensate from that turbo unit is pumped through this condenser to act as cooling or condensing water for the auxiliaries' steam. The original turbo condensate and the auxiliaries condensate, mixed together, then drop down the tail pipe into the heater tank. The results obtained are evident, for we are enabled to do away with the closed heater with its leaky tubes and repairs. There is no back pressure on the auxiliaries, and all the condensate and heat from both main unit and auxiliaries is returned to the feed water tank. A balanced relief valve is installed on the steam exhaust line to take care of the pressure when first starting up before the turbo condensate is available for condensing water.

New Appliances

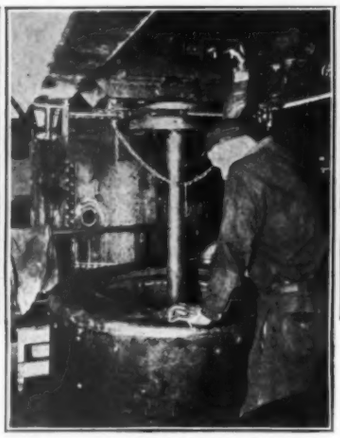
Unique and Economical Push-Button Control System—New Insulating Compound—Miniature Direct-Current Meter

Motor-Driven Centrifugal with Push-Button Control Increases Production 50%.

An interesting installation of a motor-driven centrifugal extractor entirely controlled by electric push buttons has recently been made at the plant of Kirkman & Sons, Brooklyn, N. Y. The centrifugal, which has a diameter of 40 ins., was built and installed by the S. S. Hepworth Co., and is direct-connected through a centrifugal clutch to a 25-hp., 220-volt vertical motor mounted on the floor above. While running at 500 r.p.m. the centrifugal is filled with 750 lbs. of glycerine salts. Four minutes are required for loading and the speed is then increased to 1000 r.p.m. for two minutes. After water has been supplied for washing the salts, the centrifugal is run for two minutes more at high speed, at which time all moisture has been thrown off, the complete cycle of operation requiring between nine and ten minutes.



Magnetic Control Panel for Two Speed Selection.



Through Convenient Push Buttons Operator Can Start or Stop Extractor and Run It Slowly or Fast Without Distracting His Attention.

Driving Motor Mounted on Floor Over Extractor.

Four push-button switches, placed convenient for the operator, allow complete and easy control of the centrifugal. Two buttons of the momentary-contact type are used for stopping and running, and the other two buttons provide the slow and fast speeds—500 and 1000 r.p.m.

The buttons open and close the circuits which actuate the magnetic contactors and relays on a special controller, manufactured by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis. An explanation of the operation of the controller by means of the push buttons will illustrate how perfectly the control meets the demands required of the motor and centrifugal. To start the centrifugal and run it at slow speed for loading, first the "slow" and then the "run" button is depressed. The latter causes the main-line magnetic switch to close, starting the motor with three steps of resistance in series with the armature. As the speed of the motor increases and the armature current decreases, the three accelerating lockout switches close one by one, each switch cutting out one step of resistance. They will not close, however, until the current has fallen to a predetermined value. The final switch, which shunts out all the resistance steps, is provided with a shunt coil which keeps it from dropping out should the current drop or become reversed, due to the peculiar condition pertaining to this kind of installation. This condition is produced by a sudden drop in line voltage, which causes the motor to be driven by the rapidly revolving centrifugal and generate current back into the line. The field circuit has one step of resistance, which is instantly cut out by the closing of a field-strengthening relay when the "run" button is depressed, the relay remaining closed during the acceleration to 500 r. p. m.

When the "fast" button is depressed, the field-strengthening relay opens, placing the field resistance in circuit, and the motor commences to accelerate from 500 r.p.m. to 1000 r.p.m. However, if this resistance were left in the field circuit during the entire accelerating period, the continuous heavy armature current produced would cause undue heating of the motor and, therefore, a vibrating type of field-accelerating relay is used to alternately cut the resistance in and out of circuit until the motor has reached the maximum speed. It will be noted that the field resistance is never cut in circuit until the armature resistance has first been all cut out.

The motor can be accelerated directly from a standstill to the maximum speed by depressing the "run" button while the "fast" button is "on." Depressing the "stop" putton releases the magnetic main switch which opens the armature circuit and brings the accelerating contactors and relays back to their normal positions.

The complete and easy control obtained by the push buttons allows the operator to carefully watch each run of salts, hence the best results can be obtained. In this particular installation and in others where the manufacturing process requires two operating speeds, this type of controller has been found very desirable. It is not only an inexpensive means of securing two speed operations, but it also permits the operator to secure either the slow or fast speeds by the mere pressing of a button.

It therefore enables him to devote his entire attention to the work and does not necessitate his going to and from a field rheostat located on the control panel, or elsewhere, to secure each change in speed. Furthermore, the current is limited to a safe value, and the motor cannot be accelerated too rapidly, as is sometimes the case when speed adjustment is secured through the common type of manually operated field rheostats.

Production records at the Kirkman & Sons plant show that since this automatically controlled centrifugal has been installed, the production has been increased about 50% and only 1% of the glycerine remains in the salts, whereas with the former equipment about 8% remained.

Cumar—A New Synthetic Insulating Material.

There is now being marketed a synthetic resin known by the trade name of "Cumar," which is proving of exceptional interest to manufacturers of electrical equipment.

Cumar, otherwise known as "Paracoumarone Resin," is manufactured by a special chemical process from certain coal-tar distillates. In appearance, it resembles ordinary resin but its properties are radically different; it is unaffected by water or any of the ordinary chemicals; it is neutral in its action, and unlike resin, will not saponify. It is said to be absolutely nonoxidizing so that exposure to the air or weather will not change it. Cumar is soluble in practically all commercial solvents of insulating compounds, with the single exception of alcohol. It combines readily with vegetable oils and with many waxes.

In addition to these properties, its

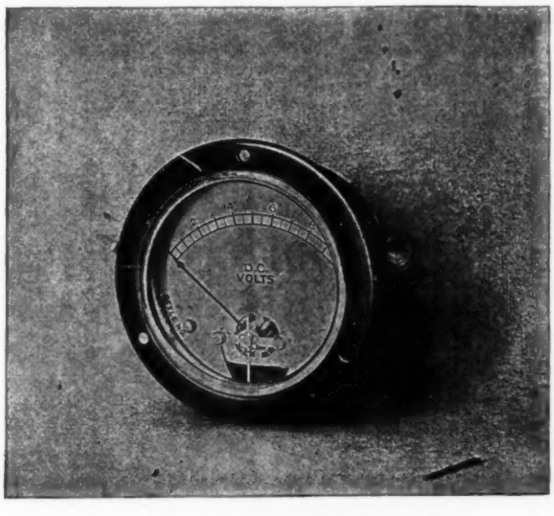
particular interest from the electrical standpoint is the fact that it has a high dielectric constant and is an excellent insulator. Resistance tests made by the Bureau of Standards on representative samples of Cumar show that in both volume and surface resistivity Cumar compares favorably with the more generally known insulating materials; in fact, the only common materials having a higher insulating power are paraffin and the ceresin waxes. A valuable property in this connection is the high surface resistivity of Cumar, particularly when exposed to moist air. In the Bureau of Standards tests, the surface resistivity dropped less than 10% when the humidity was increased from 30% to 90%. In molded insulation it is claimed that the surface resistivity is increased approximately 20% over a phenol condensation compound designed for similar uses.

The principal uses which Cumar has found so far in the electrical industry are as a base for insulating varnishes and lacquers, as a coil filler and in compositions for use in making molded insulation.

Cumar, which is manufactured by the Barrett Co., Chemical Department, 17 Battery place, New York City, is marketed in 9 different melting-point grades, ranging from a soft plastic material of melting point about 122 deg. F. to a hard brittle material with a melting point of over 302 deg. F.

Novel Type of Miniature Electrical Measuring Instruments.

With an over-all diameter of 2 9/16 in.—slightly larger than that of a gentleman's watch—and a weight of only 4 ounces, a novel type of miniature electrical instruments for the measurement of voltage and current is proving effective and reliable on small panels where economy of space, together with high accuracy and neatness of appearance, is imperative. It is especially applicable to the measurement of small direct currents, such as the filament and plate currents of radio communication sets, or those in connection with farm lighting and other small charging and lighting sets, or in use with dental and electromedical work.



Flush Type Direct-Current Voltmeter.

To meet the growing demand for instruments of small size, together with increased sensitiveness and greater accuracy, the Westinghouse Electric & Manufacturing Co. has developed this miniature type. It combines extreme delicacy of action with high sensitivity and ruggedness, and the design, construction, and materials are such that the instruments are permanently accurate.

A salient feature of design wherein these instruments differ from the other makes consists in the method of supporting the cylindrical core and movable element between the pole pieces of the magnet. Instead of providing for this purpose a casting supported at the back of the instrument independently of the magnet and pole pieces and therefore requiring, in order to secure accuracy, a high degree of machining, the new Westinghouse instruments make use of two simple, easily and inexpensively made bronze-alloy punchings securely fastened to either side of the pole pieces.

This departure makes the instrument more compact, greatly simplifies the construction, and lessens the amount of space required within the case, thereby making it practical to construct the instrument to miniature dimensions and secure at the same time a high degree of accuracy, reliability and sturdiness of design.

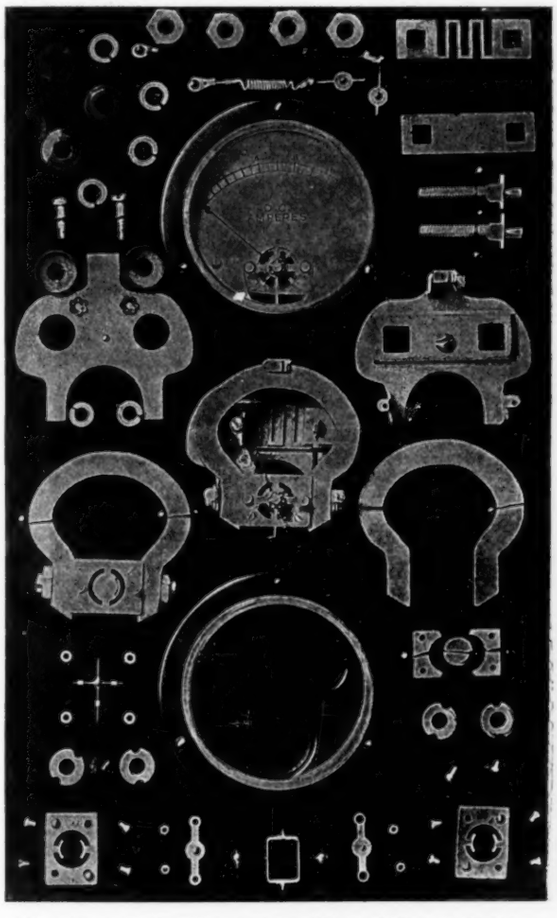
Another departure from a method in common use with other makes consists in the insulation, by oxidation instead of by paper, of the small aluminum frame which carries the coil of the movable element. The oxide of aluminum thus used is highly effective as an insulator and greatly facilitates the mounting of the coil.

The fastening of the pivot support of the movable element constitutes an additional departure from older practice. The base of the support, instead of being cemented directly to the coil, is elongated and clinched around either side of the aluminum frame of the movable coil. This gives a more accurate centering of the pivots.

By combining the millivoltmeter with a noninductive heater and thermocouple, it is made suitable for the measurement of high-frequency alternating currents, such as are encountered in radio communication. The same instrument can also be operated on alternating-current circuits of commercial frequency, provided they are not subjected to overloads.

The instruments can be furnished for mounting with the face flush with the panel, or for projection. They are arranged for rear connection. The standard finish is white dial, nickel bezel ring, and black marine case. Black-dial instruments can also be furnished, if desired.

All instruments are checked throughout their entire range for accuracy. The calibration at any point of the scale within 2% of full-scale reading on direct current and radio-frequency current of the frequencies now in use. These instruments are the smallest of the D'Arsonval (that is, moving coil and permanent magnet) type that are being regularly manufactured.



Miniature Instrument Disassembled, Showing Parts.

Trade Activities

Emerson Electric Lets Contracts for Large Factory Extension—Industrial Haulage Problems—Trade Literature

Electrical Sales Agency, with headquarters at 22 West 32nd street, New York City, would like to secure the representation of several manufacturers who are desirous of selling their product to the jobbing trade of New York, and surrounding territory. This concern would also like to entertain sole agency propositions.

Roller-Smith Co., 233 Broadway, New York, announces that its California representative, the Electrical Material Co., 589 Howard street, San Francisco, has opened a Los Angeles office in the Title Insurance building, The Los Angeles office is in charge of E. H. Bell, who has had extensive experience in marketing electrical products. The Electrical Material Co. handles the Roller-Smith lines of electrical measuring instruments, watt-hour meters and circuit breakers in California, Nevada and parts of Oregon and Idaho.

Central Electric Co., 316-326 South Wells street, Chicago, is making distribution of a new 16-page catalog dealing with Maxolite RLM standard dome diffusers, which are designed specially for use in machine shops, textile mills, woodworking plants and practically all other places where close work is done. It illustrates and describes various types of Maxolite reflectors and contains considerable technical data on industrial lighting. The Duplexalite fixture for residence ilghting, Alexalite system of illumination designed for both offices and residences, and Four-in-One lighting fixtures for store and office illumination are also illustrated and briefly described.

Hays School of Combustion, Chicago, announces that W. L. Abbott, chief operating engineer of the Commonwealth Edison Co., has associated himself with the staff of reviewing and supervising editors. Mr. Abbott is well known in the power plant field because of the responsible position he holds with the utility operating the largest power houses in the world. He ranks as one of the foremost operating and power plant engineers in the country and has contributed richly to the technical press. Mr. Abbott has always taken a keen and practical interest in young engineers and educational matters in general. For many years he was president of the board of trustees, University of Illinois, and is still on the board of trustees. He has been a prominent member of the A. I. E. E., A. S. M. E., N. E. L. A. and the W. S. E. of which latter he has been president. In matters pertaining to engineering and education, the collaborators working with Mr. Abbott are David Moffat Myers, Joseph W. Hays, Joseph Harrington, Prof. S. W. Parr, Fred Low and A. L. Rice.

Link-Belt Co., Chicago, has issued Booklet No. 421 containing an illustrated article by James Monroe on the subject, "Handling Coal and Ashes with Electric Hoists." It sets forth the marked economy in labor resulting from use of Link-Belt hoists for coal and ash handling in power plants of moderate size. In these plants many difficulties in the way of effective and economical mechanical handling were successfully overcome.

R. S. Mueller Partnership Dissolved.—The partnership of R. S. Mueller & Co., Cleveland, engaged in the manufacture of electric test clips and battery charging clips, has been dissolved as of Dec. 1, Ralph S. Mueller having purchased the interest of George G. Dusinberre. Mr. Mueller will consolidate the clip business with that of the Mueller Electric Co., and under that trade name will continue the manufacture of clips, attachment plugs, battery handles and other electric specialties.

J. L. Wolf, secretary of the Lighting Fixture Dealers Society of America, is issuing a series of letter bulletins on the advantages of carton packing for illuminating glassware and suggesting methods of putting this reform in operation. While these bulletins were prepared originally for confidential circulation to members of the fixture dealers society, it has been decided to send them on request to anyone interested in the improvement of fixture and lighting trade conditions. Copies can be secured from Mr. Wolf, care of Builder's Exchange, Rose building, Cleveland, O.

Emerson Electric Co., St. Louis, Mo., manufacturer of electric disk fans and motors, has let contracts for a new 8-story building to adjoin its present quarters, this will involve an expenditure of $600,000. The company announced about 2 weeks ago that $1,000,000 of 7% cumulative preferred stock had been issued for this purpose. The new building, which will provide employment for 1000 persons, will be equipped with an electric light and power system, a heating plant and five passenger and freight elevators. The general offices will be located on the sixth floor and the shipping rooms on the first floor. One portion of the building will contain an electric substation and there will be fireproof rooms under which will be installed gasoline and oil tanks. The remainder of the plant will be devoted to manufacturing purposes. The company has been literally inundated with orders for its products and is said to have refused orders totaling $3,000,000 during the last 4 months because its manufacturing facilities were inadequate to meet the demand for its products.

Dudlo Manufacturing Co., Fort Wayne, Ind., has recently issued a new folder, superseding all previous bulletins which includes tables giving outside diameters of its enameled, silk-covered and cotton-covered magnet wire, as well as additional data on bare copper wire.

Barkelew Electric Manufacturing Co., Middletown, O., manufacturer of Barkelew knife switches and specialties, is making distribution to the trade of a new bulletin (No. 24), 6x9 ins., giving dimensions of front connection switches for the selection of iron boxes and drilling dimensions of its knife switches. The bulletin is perforated to fit the binding strip in the back of catalog No. 22. This bulletin is also furnished in loose leaf sets, 8½x10 ins., and perforated to fit the Electrical Supply Jobbers Association binder. Any quantity of these bulletins will be furnished upon request to the company.

Lakewood Engineering Offers Unusual Inducement to Study Industrial Haulage.—As an inducement to industrial plant managers, engineers and others to study their interdepartment transportation problems and more fully realize how industrial tractors and trucks help to conserve labor and increase production, an offer of three awards for the three best analyses of the application of the new tier-lift truck is announced by the Lakewood Engineering Co., of Cleveland. To get increased production with present labor conditions is uppermost in the minds of business executives. The correct use of industrial haulage equipment will, in many cases, solve the problem. This truck is different, in every respect, from the equipment heretofore offered for plant transportation. It combines a tiering machine with a storage battery truck, thus making a load carrying unit that will, by electric power, elevate its 2-ton load to any height up to 76 ins. from the floor. Three awards—$1000, $500 and $250—are offered for the three best papers on the application of the new Lakewood tier-lift truck. The award committee, appointed by the Society of Industrial Engineers, consists of: A. Russell Bond, chairman, editor Scientific American Supplement, New York City; Professor Dexter S. Kimball, dean of the School of Engineering, Cornell University, Ithaca, N. Y., and Irving A. Berndt, president of C. E. Knoeppel & Co., New York City. All papers must be in the hands of Mr. Bond by Jan. 30, 1920. The awards will be made prior to Feb. 28, 1920. Details of the contest will be sent by the Lakewood Engineering Co., Cleveland, upon request. The contest is open to all except employes of the Lakewood Engineering Co.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

Otter Cliffe, Me.—The Bureau of Yards and Docks, Navy Department, Washington, has had plans prepared for the erection of a new radio station at this place.

North Stratford, N. H.—Warner Sugar Refinery Co., 70 Wall street, New York, has arranged for the erection of a 1-story power plant, 64x120 ft., at its local works.

Springfield, Mass.—New England Westinghouse Co., Chicopee Falls, is planning for the construction of an addition to its plant at East Springfield to cost about $150,000. The structure will be equipped for the manufacture of small motors.

Bridgeport, Conn.—Bryant Electric Co. has filed plans for the erection of a machine works and automobile service building for company cars, 1 story, 56x117 ft., to cost about $10,000.

Cranston, R. I.—United Wire & Supply Co., Auburn, will build a 2-story addition to its plant, 40x250 ft., to cost about $100,000.

Buffalo, N. Y.—Intervillage Electric Corp., Buffalo, has been merged with the Depew & Lancaster Light, Power & Conduit Co., Depew, N. Y., under the latter name.

Churchville, N. Y.—An electric power plant and transmission line will be erected by Alderman, Fairchild & Co., 367 Orchard street, Rochester.

Fillmore, N. Y.—Genesee Valley Power Co. is planning to extend its service by an electric line from Fillmore to Belmont, to allow lighting Belfast and Angelica en route. Work on the new line will begin early in the spring. The corporation now serves the villages of Fillmore and Pike.

Livingston, N. Y.—Livingston-Niagara Power Co. has increased its capital to $150,000 for proposed expansion.

Long Island City, N. Y.—Queens Electric Light & Power Co. has filed plans for the erection of a new 1-story automobile service plant for company trucks and cars, 38x200 ft., on Read street, near Jane street, to cost about $150,000, including equipment installation.

New York, N. Y.—Western Electric Co., 195 Broadway, has leased the 7-story building at 537-45 Greenwich street, 100x100 ft., for a term of years at an aggregate rental of $300,000. The company will use the structure for different features of business.

New York, N. Y.—Central & South American Cable Co. has entered into contract with the Government of Brazil for the construction of a new cable line from Rio Janeiro to Cuba. This assures a direct all-American line from the United States to Brazil.

New York, N. Y.—Vermont Hydro-Electric Co. has filed notice of authorization to operate in New York, with capitalization of $1,000,000. C. N. Wilson, 50 Pine street, is representative.

New York, N. Y.—Western Union Telegraph Co. has been granted permission by the Government of Peru to establish a new cable relay station at Pimentel, Peru, a point about midway of the projected cable line of the company, approved by the Government of Chile, on Nov. 27. Construction work will be inaugurated at an early date.

Schenectady, N. Y.—General Electric Co. is completing plans for the erection of a 6-story building at its local works, 54x219 ft., to cost about $400,000. Harris & Richards, Drexel building, Philadelphia, Pa., are architects.

Schenectady, N. Y.—Weber Electric Co. has increased its capital from $25,000 to $100,000.

Bayonne, N. J.—In connection with the erection of a large addition, the Bayonne Hospital, East 30th street, near the City Hall, will build a new power plant for service at the institution and a mechanical laundry works. The entire project is estimated to cost about $250,000.

Camden, N. J.—Eavenson & Levering, operating a wool scouring plant, have arranged for the installation of new boilers and auxiliary equipment for increased power capacity.

Dover, N. J.—Electrical and mechanical equipment will be installed by the Republic Steel Co., formerly known as the Wharton Steel Co., in connection with improvements and extensions at its blast furnaces and steel plant at Wharton. An electrically operated ore bridge will be constructed, new blast furnaces erected, coke ovens installed, and plans are under way for a new steel finishing plant and sintering works. The project is estimated to cost about $3,000,000. H. M. Roche is consulting engineer; the work will be carried out under the supervision of Arthur G. McKee & Co., Cleveland, Ohio.

Metuchen, N. J.—Large quantities of electrical apparatus have been sold by the Emergency Fleet Corp. at public sale conducted from its local warehouse. Among the different items and prices are 6000 Edison plug fuses, 4 cts. each; dry batteries, 25 cts. each; telephone line stations, $5 each. More than 1000 different items are being sold.

Newark, N. J.—New York Telephone Co. has perfected plans for the proposed extensions to its exchange plants in this vicinity to cost about $650,000. The main building at 281-285 Washington street will be increased in height from 9 to 13 stories, at a cost of about $300,000; an addition will be erected to the exchange plant at 59 Bloomfield avenue to cost $200,000; and an extension made to the exchange at 176 Avon avenue to cost $150,000.

Perth Amboy, N. J.—Considerable electrical and mechanical machinery and equipment will be required for the large addition to be constructed at the plant of the Perth Amboy Dry Dock Co., foot of Broad street. A new dry dock, mechanical and electrical shops will be constructed. Lockwood, Greene & Co., 101 Park avenue, New York, are architects and engineers.

Trenton, N. J.—Hildebrecht Ice Cream Manufacturing Co. will build a new ice and refrigerating plant to cost about $30,000. Considerable electrical equipment will be installed.

Trenton, N. J.—Crescent Insulated Wire & Cable Co., Olden and Taylor streets, has acquired additional property on Webster street for the erection of an addition to its works. The company will install oil-burning equipment in its power plant, changing from coal to such type of fuel for general operation.

Whitehouse, N. J.—The Readington Township Committee is planning for the installation of an electric light and power system in this section. A lighting district has been mapped out, and it is proposed to enter into negotiations with some of the neighboring power companies to extend their lines to this point. County Engineer Grant Davis will be in charge.

Wilmington, Del.—Plans have been filed by the Standard Kid Manufacturing Co., 4th and Monroe streets, for the erection of a new 1-story boiler plant, about 40x40 ft.

Wilmington, Del.—Unger Storage Battery Co., 12th and Madison streets, has filed plans for the erection of a 1-story addition to its plant.

Allentown, Pa.—The engine plant at the stone quarries of Herbine & Ziegenfus was destroyed by fire on Dec. 14. The plant will be rebuilt.

Allentown, Pa.—Electric Bond & Share Co., 71 Broadway, New York, has inaugurated construction work on extensions to its power stations and transmission lines in this section. The work is estimated to cost $3,000,000.

Freeburg, Pa.—Northumberland County Gas & Electric Co., Sunbury, is planning for the installation of an electric light and power system here.

It is proposed to have the new system ready for service by the coming spring.

Hazleton, Pa.—A new coal washery will be constructed at the Silver Brook mining properties, to be electrically operated. Service will be furnished by the Harwood Electric Co.

Johnstown, Pa.—To provide for its new power project, the Penn Public Service Co. has arranged for a bond issue of $4,000,000. The company has preliminary work under the way on a new steam-driven power plant at Seward, near Johnstown, to cost about $1,500,000. Operations are conducted in Cambria, Somerset, Indiana, Clearfield, Centre and Westmoreland counties and general expansion work is planned. The territory served has a population of about 400,000.

Philadelphia, Pa.—A new 1-story boiler plant, 42x66 ft., to cost about $25,000, will be constructed by the Continental Mills Co. at its plant at Armat and Lena streets.

Philadelphia, Pa. — Manufacturing Co. of America, 12th and Hamilton streets, will install new boiler equipment at its power house for increased capacity.

Philadelphia, Pa. — Construction work has been commenced on the boiler plant to be erected at the new factory of the American Preserve Co., 946 Beach street; the structure will be 50x70 ft. The entire plant is estimated to cost $400,000.

Philadelphia, Pa. — The largest shipbuilding crane ever constructed has been placed in operation at the League Island Navy Yard of the Government at Philadelphia. The crane is electrically operated throughout; it has a lifting capacity of 350 gross tons, and is equipped with an auxiliary hoist, operating on a horizontal trackway between the two main 175-ton hoist runways. It is of stationary pintle cantilever type. The crane was built by the McMyler-Interstate Co., Cleveland, Ohio, and will be used for fitting out work at the yard.

Pittsburgh, Pa.—Pittsburgh Reflector & Illuminating Co., a New Jersey corporation, has increased its capital from $15,000 to $50,000.

Pittsburgh, Pa.—Jones & Laughlin Steel Co. has filed plans for the construction of a new 1-story pumping plant on 2d avenue, near Bates street, to cost about $15,000.

Reading, Pa.—Metropolitan Edison Co. has closed a 5-year contract with the Eastern Pennsylvania Railways Co., operating at Pottsville and vicinity, for electric energy, providing for a minimum of 2000 kw. and maximum of 4500 kw.

Wilkes-Barre, Pa.—Kitsee Battery Co., 62 North Main street, will build a 1-story addition, 40x80 ft., to cost about $10,000.

Annapolis, Md.—The Bureau of Yards and Docks, Washington, has awarded a contract to the Levering & Barrigues Co., 552 West 23d street, New York, for the erection of a new power plant at the local navy yard.

DATES AHEAD.

American Society of Civil Engineers. Annual meeting, New York City, Jan. 21-22, 1920. Secretary, Charles W. Hunt, 33 West 39th street, New York City.

Western Association of Electrical Inspectors. Annual convention, St. Louis, Mo., Jan. 27-29, 1920. Secretary, W. S. Boyd, 175 West Jackson boulevard, Chicago, Ill.

National Council of Lighting Fixture Manufacturers. Annual convention, Detroit, Mich., Feb. 9-13, 1920. Secretary-treasurer, Charles H. Hofrichter, Cleveland, O.

Oklahoma Utilities Association. Annual convention, Oklahoma City, Feb. 10-13, 1920. Secretary, H. A. Lane, 611 State National Bank building, Oklahoma City.

Central Electric Railway Association. Annual meeting, Louisville, Feb. 26-27. Secretary, A. L. Neereamer, Indianapolis, Ind.

American Electrochemical Society. Annual convention, Boston, Mass., April 7-10, 1920. Friday, April 9, joint session with American Institute of Electrical Engineers on "Electrically Produced Alloys." Secretary, Joseph W. Richards, Bethlehem, Pa.

National Electric Light Association. Annual convention, Pasadena, Cal., May 18-21, 1920. Headquarters, Hotel Huntington. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

National Association of Electrical Contractors and Dealers. Annual convention, Baltimore, Md., Oct. 6, 1920. Secretary, W. H. Morton, 110 West 40th street, New York City.

The contract covers the building work.

Baltimore, Md.—Consolidated Gas, Electric Light & Power Co., Lexington building, is planning for the erection of a 2-story factory, 53x100 ft., on Kloman street, to cost about $50,000. The structure will be equipped for the manufacture of gas appliances.

Salisbury, Md.—Eastern Shore Gas & Electric Co. has arranged for a preferred stock issue for general expansion. The company serves this section with electric light and power.

Bluefield, W. Va.—American Armature Engineering Co., recently incorporated with a capital of $25,000, is planning for the establishment of a local electric plant. A. A. Grant and A. D. Knight head the company.

Weston, W. Va.—Weston Milling Co. is planning for the construction of a new transmission line to Seeber to cost about $50,000. George I. Keener is president.

Weirton, W. Va.—In connection with the construction of the proposed new plant of the Weirton Steel Co., contracts for which have recently been awarded, arrangements have been made for the construction of a large extension to the blast furnace power station, providing for the installation of 5 600-hp. boilers equipped with underfeed stokers. The installation will comprise 2 7500-kw. turbogenerator units, as well as switchboard and auxiliary apparatus. Large quantities of electrical equipment will be required in connection with the construction of the mills proper, and contract has been awarded to the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., for the furnishing of 2 4000-hp. motors; 2 1500-kw. motor-generator sets to be installed in the direct current substation at the blooming mill; contract has been let to the General Electric Co., Schenectady, N. Y., for switchboard equipment; the Power Specialty Co., New York, will supply a 600-hp. waste heat boiler equipped with super heaters; while the Vulcan Soot Cleaner Co., Chicago, has been awarded the contract for soot blower equipment. When completed, the new plant will have an annual capacity of about 400,000 tons of ingots, and the company is arranging for the completion by June, 1920.

Hertford, N. C.—The Board of Trustees has approved a bond issue of $125,000 for improvements and extensions in the municipal power plant and city water works.

Lakeview, N. C.—Electric Light & Power Co. has increased its capital from $75,000 to $300,000 and contemplates plant enlargement. J. R. McQueen is president.

Conway, S. C.—Conway Lumber Co. is in the market for a 25-kw. generator, 3-phase, 60-cycle, 240-volts, belted or direct connected.

Denmark, S. C.—American Telephone & Telegraph Co. will erect a $75,000 to $100,000 office building. It will be 3 stories high and used for lunch room, employment and operating room, etc.

NORTH CENTRAL STATES.

Dover, O.—The city voted bond issue of $100,000 to enlarge its municipal electric plant and to replace natural gas engines with steam engines.

Bad Axe, Mich.—A committee has been appointed to look into ways and means to improve water system. The committee also agreed that there are but two things in sight—either the sale of the present plant and a franchise to private parties or a new municipal plant, which it is estimated would cost at least $75,000. The committee is now working on the proposition.

Charlotte, Mich.—The city council is interested in the proposition of the advisability of installing an electrical equipment at the city water works station.

Muskegon, Mich.—Shaw Electric Crane Co. contemplates an addition to its plant which will double its capacity.

Colfax, Ind.—Colfax Electric Co. has petitioned for authority to issue $20,000 in bonds for extension to light system. Address general manager.

East Chicago, Ind.—Bates Expanded Steel Truss Co. of East Chicago and Savona, Italy, has opened its new plant at Savona. It was built by Walter Bates and is a duplicate of the one at East Chicago. The Bates company manufactures latticed steel poles and has had heavy contracts from the ministry of railways of Great Britain and from traction companies in Swedish cities. Large numbers of the poles are in use in Africa and India.

East Chicago, Ind.—In an application to the Indiana Public Service Commission for permission to issue bonds for $161,000 for the completion of its filtration plant at East Chicago, the East Chicago and Indiana Harbor Water Co. stated that construction work to date had cost $244,199. According to these figures the filtration plant when completed will cost the company $405,699. The original estimate was $225,000. The headquarters of the East Chicago and Indiana Harbor Water Co. are at Indianapolis, Ind.

Indianapolis, Ind.—Liquid Carbonic Co. of Chicago has purchased a site and will erect a plant for the manufacture of carbonic gas. J. B. Olwin, manager of the Liquid Carbonic Co. of Chicago.

Indianapolis, Ind.—The Indiana Telephone Association has been incorporated with the purpose of protecting investments in telephone properties. The organization is composed of all the telephone companies of the state. Among those interested are Claude R. Stoops, Napanee; William N. Bailey, Richmond, and Frank O. Cuppy, Lafayette.

Indianapolis, Ind.—Prest-O-Lite Co. will build a 2-story battery house, 100x400 ft. to cost $400,000.

Logansport, Ind.—The Cass County Chamber of Commerce will have a survey made of the Wabash river at Logansport with a view of using power of the river for an electric power and light plant.

Chicago, Ill.—A new plant 27x306 ft., is contemplated by the Federal Electric Co. and will involve an expenditure of $150,000.

Chicago, Ill.—The trustees of the sanitary district have decided to build a new hydro-electric plant at Lockport. Its construction will take "the major portion of two years," cost an aggregate of $2,000,000, of which the trustees agreed that $750,000 shall be spent next year, and increase the gross revenue of the district from electric energy "above $300,000 annually."

Bruce, Wis.—The sum of $12,000 in bonds has been voted for municipal lighting system. L. H. Stenson, city clerk.

Colfax, Wis.—Colfax Light & Power Co. will spend about $200,000 to increase the capacity of its hydro-electric plant.

Lancaster, Wis.—Farmers' Telephone Co. will erect telephone exchange and office building on East Maple street. The building will be 2 stories, and of brick construction. Work will be started in the spring. Estimated cost $50,000.

Milwaukee, Wis.—Mueller & Son Co. will completely electrify its plant by the installation of a large generator and 65 motors of various sizes.

Tomah, Wis.—Tomah Electric Light Co. contemplates a light plant. Louis W. Barnes, architect, Superior street. Superintendent has not yet been selected.

Waupaca, Wis.—Little Wolf Power Co. will construct power plant and dam on Little Wolf River. Dr. W. H. Finney, Clintonville, is interested. Engineer, L. A. DeGuere, Grand Rapids, Wis. Work is to start Jan. 1 and be completed June 1.

Washburn, Wis.—Wisconsin Telephone Co. has purchased the Bayfield County Telephone Co. New instruments will be installed.

Belview, Minn.—Northern States Power Co., Garrett, O. House, manager, 76 W. 3rd street, will extend its line from Belview, Minn., to Sacred Heart.

Bemidji, Minn.—A company has been formed to install Helga Twp. Telephone line from Bemidji to Helga, 13 miles southwest of here. Line will connect Northwestern Exchange line at M. & I., 2 miles southeast of here. Full metallic line. Adner Stone, secretary of the company.

Clearbrook, Minn.—Clearbrook Electrical Co. will build a power house.

Buffalo, Mo.—The proposition of installing street lights is under consideration.

Brunswick, Mo.—The sale of the Brunswick Light & Water Co.'s plant and lines to the Carrollton Water, Light & Transit Co. has been approved by the State Public Service Commission. The trade includes the sale of the local company's light and water plants here as well as the transmission lines extending from Brunswick to Dalton, Keytesville, Triplett and Mendon. In addition to the Chariton county towns, the Carrollton company will also furnish light to DeWitt, Wakenda, Bosworth, Bogard and Tina, in Carrol county. This will form one of the largest country lighting systems in the state.

Marshfield, Mo.—L. A. Reynolds and T. F. Bowers of Flat River, Mo., have made a contract to purchase the electric light plant from the city of Marshfield and in payment have agreed to furnish the city with lights for a period of 5 years which would amount to $7300.

Maryville, Mo.—Permission was granted by the county court to the Mound City Electric Light & Ice Co. to erect a transmission line from Clyde to Stanberry.

Shannondale, Mo.—Shannondale Light & Power Co. has been chartered with a capital stock of $6000.

Meridan, Kan.—A transmission line is to be rebuilt in the near future to Topeka, a distance of 15 miles. W. B. Rollins, 209 Railway Exchange building, Kansas City, Mo., consulting engineer.

Ness City, Kan.—Election to vote $50,000 bonds for the enlargement of the light plant carried at the recent election. A new 250 hp. engine and generator and other necessary equipment will be installed.

Preston, Kan.—Election to vote bonds in the sum of $31,000 for waterworks improvements is contemplated. L. C. Mosier, city clerk.

Havelock, Neb.—Omaha-Lincoln & Denver Railway will construct 3 interurban lines through the city.

McIntosh, S. D.—A new municipal light plant will be built in the spring. Address city clerk.

Ree Heights, S. D.—E. L. Hager will install 2-hour service electric light plant. L. A. Finnegan, city auditor.

Fargo, N. D.—An election was held by citizens' committee whereby it was voted to issue $150,000 in bonds for municipal lighting.

Mayville, N. D.—R. W. Richards, Western Equipment Co., 63 East 6th street, St. Paul, Minn., will submit estimates to the city council for a light plant.

SOUTH CENTRAL STATES.

Louisville, Ky.—Power and lighting plants and other utilities will be installed by the Country Home Power & Lighting Co. which applied for a charter, with a capital stock of $30,000. W. Ray, Owensboro, president.

Byron, Okla.—Bonds have been voted for an electric light plant.

Donna, Tex.—Donna Light & Ice Co. is understood to be arranging plans for the enlargement of its electric light and power plant, to increase the present capacity. The company has filed notice with the Secretary of State of an increase in its capital stock from $10,000 to $40,000, to provide for the proposed expansion.

Fort Worth, Tex.—C. O. Thorp of Fort Worth has made application to the state engineer of New Mexico for a permit to construct a reservoir and hydroelectric plant on the Pecos river about 5 miles north of the Texas line. The site of the proposed reservoir is near Red Bluff. The project will cost about $600,000.

Kennedy, Tex.—Fire on Dec. 11, which caused a loss of $75,000, destroyed the power plant of the Kennedy Light & Power Co. It is understood that the company is considering plans for immediate rebuilding.

Lufkin, Tex.—Final details are being worked out for the installation of the white way, which will begin about the first of the year, at a cost of approximately $6000.

McLean, Tex.—T. V. Webb, proprietor of the McLean Motor Co., has made arrangements to install an electric light plant of sufficient size to light the business section of the town.

Pittsburg, Tex.—Home Light & Ice Co. plans improvements to its plant involving an expediture of $30,000. Motor-driven ice-making equipment of 20-ton capacity, boilers, etc., will be installed.

Ranger, Tex.—Southwestern Telegraph & Telephone Co. will soon start the construction of a new building to cost between $50,000 and $100,000. J. A. Williams, district manager.

Rock Springs, Tex.—Rock Springs Light Co. will construct an electric light and power plant here. V. A. Brown is a stockholder.

Waco, Tex.—Central Texas Electric Co. of Waco, which plans to construct an interurban electric railway between Belton and Austin, about 50 mi., and between Waco and Temple.

about 60 mi., has appointed B. A. McCarthy, of the Central Texas Engineering & Construction Co., chief engineer. The survey for the proposed line between Belton and Austin is now being made. The project involves the construction of a large electric power station, which will be probably located at Austin.

WESTERN STATES.

Ryegate, Mont.—Montana Power Co. will erect power line to Ryegate for light and power.

Buhl, Ida.—City contemplates a bond issue for waterworks and municipal light system. James J. Chambers, Denver, Colo., interested.

Winnemucca, Nev.—George Wingfield is interested in a $200,000 hotel to be erected. The company also plans to maintain its own electric light plant in the hotel.

Ogden, Utah.—A large storage battery manufacturing plant is to be erected in this city by the Western D-G. Storage Battery Co. Estimated cost $200,000.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Goods (31,542).—A firm of importers and general commission merchants in India desires to represent manufacturers of hardware, engineers' tools, boiler fittings, mill machinery, electrical fittings and accessories, dynamos and motors, motor cars, etc. Reference.

Material for Electrical Tramways (31,547).—An engineer in Belgium desires to secure the exclusive agency for the sale of machine tools, material for electrical tramways and for steel construction. Quotations should be given c. i. f. Antwerp. Terms, credit of 90 days. Correspondence may be in English. Reference.

Electrical Goods (31,583).—An electrical engineer in Spain desires to secure an agency for the sale in southern Spain of electrical goods, appliances and machinery. Reference.

Electric Light Apparatus (31,590).—A firm of importers in the Netherlands desires to purchase or secure an agency for the sale of automobile accessories, especially electric light apparatus, combined or not combined with electric starter. Reference.

PROPOSALS

Municipal Light Plant.—Bids will be received Jan. 5 for the construction of a $25,000 municipal electric light plant at McIntosh, S. D., to supply electric light, heat and power. L. A. Finnegan, city auditor.

Generating Equipment.—Bids will be received until Jan. 5 by C. L. Trueblood, city clerk, Whittier, Cal., for furnishing and installing 2400 tons 4-24 in. classes B and C c. i. water pipe fittings and equipment for pumping water and generating 200 kw. electric current. Alternate bids for pumping and generating will be taken as follows: (1) 12 x 36-in. high duty cross compound double acting crank and flywheel pumping engine, 2 150-hp. water-tube boilers and one 200-kw. steam turbine generator; (2) same as preceding, excepting generator; (3) 2 direct connected 2200 g.p.m. centrifugal pumps and motors.

NEW PUBLICATIONS

Determination of the Output Characteristic of Electron Tube Generators is the title of Scientific Paper No. 355 by Lewis H. Hull, assistant physicist of the Bureau of Standards, and issued by that bureau of the Department of Commerce, Washington, D. C. The author points out that owing to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit, when used as a generator, are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit acts as a filter in series with the tube and the direct current power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents, depending in amplitude solely upon the fundamental constituents of the tube currents. General expressions are derived for the power and current output in terms of static characteristics of the generating tube, and are corroborated by experimental results obtained with a particular tube. The price of this publication is 5 cts. and copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

INCORPORATIONS

Indianapolis, Ind.—I. V. Zelander Manufacturing Co. has been incorporated with capital of $25,000 for the manufacture of electrical supplies. The directors are I. V. Zelander, R. A. Coombs and Elmer Kidwell.

Goose Creek, Tex.—Goose Creek Light Power Co. has been incorporated here with a capital stock of $75,000, and will construct an electric light and power plant. The incorporators are W. W. Sloan, R. S. Sterling and T. D. Joiner, Jr.

Lone Star, S. C.—Lone Star Telephone Co. has been incorporated with a capital of $1000. G. Keister, president, and P. C. Way, treasurer.

Tuskegee, Ala.—Tuskegee Light & Power Co. has been incorporated with a capital of $30,000 to operate electric light and power plants and ice plant. D. E. Laslie and others interested.

New York, N. Y.—Sherwood Motor Repair Co., Inc. Capital, $25,000. To operate motor repair works, etc. Incorporators: S. H. Doughty, H. R. Croley and P. A. Zizelman, 28 Park Row, New York.

Malone, N. Y.—Pond Electric & Battery Service, Inc. Capital, $20,000. To manufacture electrical goods, batteries, etc. Incorporators: F. O. Pond, F. R. Kirk and V. E. Maher, Malone.

East Orange, N. J.—Motor Starter & Air Pump Co. Capital, $200,000. To manufacture motor starters and other motor equipment. Incorporators: Gordon Grand, East Orange; E. O. Gordon Grand, E. O. Picking and M. V. McKenzie, East Orange.

Newark, N. J.—Hochbaum-Rylander Co. Capital, $100,000. To manufacture and deal in electric fixtures, etc. Incorporators: Fred and M. Hochbaum, and Ernest Rylander, South Orange.

Wilmington, Del.—Superior Spotlight Co. Capital, $100,000. To manufacture electric flashlights and other electrical goods. Incorporators: M. E. Doto, Horace G. Eastburn and Charles P. Colton, Wilmington.

Indianapolis, Ind.—Volta Battery Co. has been incorporated with a capital of $10,000 to manufacture electric batteries.

Koshkonong, Wis.—Koshkonong Light & Power Co. has incorporated with a capital of $75,000 to erect light and power plant. A. R. Hoard, Ft. Atkinson, John Hetts, Oval, Swart, R. F. D. Ft. Atkinson, interested.

Indianapolis, Ind.—Roll-a-Rocker Co., dealers in electrical specialties, has been incorporated with capital of $15 000 by J. M. Hunter, J. H. Hornstein and Harry K. Lange.

Caroline, Wis.—Caroline Electric Co. has been incorporated with a capital of $6,000. D. F. Breed, Gust A. Radtke, Roy E. Van Behaick, C. B. Hanson, F. R. Bust.

Marion, Ky.—Marion Light, Ice & Coal Co. Capital, $40,000. To operate a local electric and ice manufacturing plant. Incorporators: S. Gugenheim, T. H. Cochran, and O. S. Denny.

New York, N. Y.—East Coast Electrical Supply Co. Capital, $15,000. To manufacture electrical supplies. Incorporators: W. J. Fisher, T. Christianson, and J. V. Schraig, Richmond Hill.

New York, N. Y.—Cellokay Manufacturing Corp. Capital, $500,000. To manufacture special machinery for motor service, etc. Incorporators: Joseph Rucker, W. H. Peck, and A. E. Atherton, 510 West 124th street.

Philadelphia, Pa.—Ward Electric Co. Capital, $30,000. To manufacture electrical goods. Incorporators: Philip H. Ward, Jr.; Ralph P. Ward, 1421 Arch street; and M. L. Brown, Philadelphia.

Personals

W. R. Molinard Resigns—C. S. Beardsley Vacuum Cleaner Manufacturers' Association President—S. P. Brown Dies

FRANK H. BETHELL, formerly vice-president of the New York Telephone Co., New York, recently resigned, was tendered a testimonial dinner at the Telephone Club by his former associates on his retirement from the company.

W. CAMERON FORBES, of Boston, at one time Governor-General of the Philippine Islands, has been elected a director of the American Telephone & Telegraph Co. His father, W. H. Forbes, was president of the first Bell telephone organization.

W. C. BRIGGS, formerly New York district manager of the Shepard Electric Crane & Hoist Co., New York, has accepted a position with the Pennsylvania Crusher Co., Philadelphia. He is succeeded in the New York office of the Shepard company by R. W. Hurst.

ERNEST W. PELTON, for the past 16 years connected with Stanley Works, New Britain, Conn., as mechanical engineer, has become manufacturing superintendent of the hardware factory. He will retain supervision of the electrical and power, as well as the engineering, mechanical and transportation departments.

H. W. GRAEBER, assistant superintendent of construction of the Oklahoma Gas & Electric Co., Oklahoma City, has been promoted to the position of superintendent of construction, effective Jan. 1. He succeeds to the position of H. W. Reilly, who will on that date assume the office as vice-president in charge of operation.

R. DE VERE HOPE, recently discharged from the United States Army, where he was stationed at Edgewood Arsenal in connection with the manufacture of mustard gases, has entered the organization of the Duratex Co., as industrial engineer. Prior to entering the army he was for a number of years connected with the engineering department of the New York Telephone Co.

F. S. MONTGOMERY, for the past 6 years advertising manager of the National Metal Molding Co., Pittsburgh, has tendered his resignation, effective Dec. 31, to become associated with the Ivan B. Nordham Co., outdoor advertising, 8 West 40th street, New York. Prior to becoming advertising manager, Mr. Montgomery was for several years district manager in charge of the Atlanta office of the company.

W. R. MOLINARD, vice-president in charge of operation of the Oklahoma Gas & Electric Co., Oklahoma City, has resigned, effective Jan. 1, and will be succeeded by H. W. Reilly, superintendent of construction for the Oklahoma properties. Mr. Molinard has served the Byllesby organization in important capacities since 1912 and leaves the company to go to California on account of private interests there.

C. F. GRAY, electrical engineer, Winnipeg, Manitoba, has been re-elected mayor of that city by more than 2500 majority.

HENRY L. LIDDELL has been appointed instructor in the civil engineering department of the Massachusetts Institute of Techonology.

J. L. HARPER, chief engineer of the Niagara Falls Power Co., Buffalo, N. Y., recently tendered an interesting address at the meeting of the Builders' Exchange at the Chamber of Commerce Club Rooms, Buffalo. Mr. Harper set forth that water power, in his opinion, could never entirely replace the use of coal, and spoke in a very entertaining manner on the latest power development project at Niagara Falls, whereby an efficiency of 90% is realized from the water used, which is said to be the highest efficiency ever attained in the world.

CHARLES S. BEARDSLEY, chairman of the newly organized Vacuum Cleaner Manufacturers' Association, is

Charles S. Beardsley.

general manager of The United Electric Co., Canton, O. He became associated with the company in his present capacity about 2 years ago and in this brief period has made a notable record in his administration of the company's affairs, and has introduced many novel ideas for the merchandising of household appliances which have been profitable to the industry as a whole. He has had a broad experience in merchandising and his sound training in advertising methods, coupled with the thorough mechanical knowledge which he possesses, accounts for the prominent position The United company occupies in the industry.

Obituary.

RALPH L. SHAINWALD, president of the Standard Paint Co., New York City, manufacturer of insulating paints and compounds, died on Dec. 10.

WILLIAM F. THOMAS, for the past 21 years connected with the Public Service Corp., and more recently manager of the New Brunswick, N. J., district of the company, died on Dec. 17.

STEPHEN PEARSON BROWN, a prominent eastern engineer, died in Sebec Lake, near Dover, Me., Dec. 13. He was pulling his 9-year-old son on a sled when the ice broke under him and he sank before the boy could summon help. Mr. Brown was born in Dover, Me., April 29, 1877. He attended the Foxcroft Academy, Foxcroft, Me., the Hotchkiss School, Lakeville, Conn., and graduated from the Massachusetts Institute of Technology with a B. Sc. degree in mechanical engineering in 1900. From 1900 to 1903 he was a junior partner of Collier & Brown, consulting engineers, Atlanta, Ga., and was engaged on hydroelectric developments, mill construction, municipal steam driven electric lighting plants, waterworks, sewage systems, etc. From 1904 to 1905 he was inspector for the N. Y., N. H. & H. R. R. From 1905 to 1909 he was with the United Engineering & Contracting Co., of New York, in various capacities. From 1909 to 1912 he was chief engineer of the Tidewater Building Co., and T. B. Bryson, building section 11-A-3 of the Fourth Avenue Rapid Transit subway in Brooklyn. In 1912 he became chief engineer of the Mount Royal Tunnel & Terminal Co., Ltd., and managing engineer for Mackenzie, Mann & Co., Ltd., having charge of both the design and construction of the terminal development in Montreal for the Canadian Northern railway. This includes a double track tunnel over three miles long, elaborate freight and passenger terminals and an elevated double track viaduct across the lower town from the tunnel to the harbor. It involves an expenditure of $15,000,000. In 1916 he was vice-president and manager of Ford, Bacon & Davies, a well-known firm of engineering contractors of New York City. He continued to act in a consulting capacity in regard to the Montreal terminal work for the C. N. R., and was expected in that city this month on business in connection with the C. N. R. enterprise. From 1915 to 1917 he was a member of the council of the Canadian Society of Civil Engineers. He was a member of the American Society of Civil Engineers, of the American Society of Mechanical Engineers, of the American Railway Engineering Association, of the Canadian Society of Civil Engineers and of the Institution of Civil Engineers (British).

Financial News

Electric Railways Best Operated by Private Capital.

Only by the use of private capital and enterprise can the electric railways of the United States be made to function properly, Bentley W. Warren, counsel for the Committee of One Hundred of the American Railway Association, declared in a brief filed with the Federal Electric Railway Commission, which will probably report the result of its investigation made last summer to President Wilson some time this month.

In connection with this statement Mr. Warren declared that legal and financial obstacles in the way of government acquisition of public utilities and the great divergence of opinion as to the desirability of the plan prevented at the present time the successful operation of public ownership.

If private capital and enterprise is to continue to be used in the local transportation field, the brief declares, it is essential that the credit of the industry be re-established, since a continuing supply of new capital is necessary to permit these utilities to keep pace with the demands of the public.

Credit Extension to European Countries a Vital Need.

The importance of wide public support in the matter of supplying European credits is emphasized in the current issue of "American Goods and Foreign Markets," the semi-monthly review of foreign trade conditions issued by the Guaranty Trust Co. of New York.

The publication says that while manufacturers and exporters are thoroughly acquainted with the implication and inevitable effects on foreign trade if the drop in exchange is not checked, "it is not quite clear that it is understood by the general public, and particularly by those who have funds for investment, that their co-operation is esential if the present situation is not to continue indefinitely.

"Yet," the review continues, "it must be evident to the casual observer that Europe cannot produce the necessities of life in sufficient quantities until the means of production are there. For five years, the normal operation of industry gave way to the highly specialized and non-productive operations of war time. The means of transportation, except along those roads needed for the moving of munitions and troops, were allowed to deteriorate. Machinery, necessary to the production of goods for the consumption of the people, wore out and was not replaced. Stocks of raw materials were used up or diverted to uses which did not go to the satisfaction of the daily wants of the people. All this continued for five years. The resultant loss was almost incalculable. In coming back into production to an extent sufficient not alone to meet the needs of her own people, but also to sell goods abroad sufficient to pay the accumulated debt of years, the countries of Europe had a task almost as difficult as that of carrying on the war. In one sense it was more difficult, for during the war the energies of the people were stimulated by fear, or patriotism, or some other emotion, which made continued and uninterrupted effort a matter of vital necessity.

"At the end of the war, Europe needed, first of all, food and clothing. That was forthcoming from the United States in short order. To send it, however, put a new burden upon the credit resources of the people, and started the exchanges on their downward path. Next, Europe needed raw materials, for the factories and mills which were in condition to begin operations. These too were forthcoming, and exchanges sagged again, for as yet Europe was not in production, and could not pay in goods the enormous balances which were being piled up against her. Finally, and most of all, however, she needed capital goods—machine tools, rails, locomotives, electrical equipment, all that great group of products which are necessary for the existence of a modern industrial nation. These are the very vitals of industry, and until they are forthcoming, Europe cannot count industrially in the world market as she counted before the war. And, by the same token, she cannot produce the consumption goods upon which her export trade depends. Until it is possible for Europe to sell for export, the shortage of consumption goods in the world will be keen, and prices for the necessities of life will be high everywhere.

"To date, the arrangements made for the supplying of credit to European industry have not been of sufficient scope to meet the needs of the situation, as the constantly sagging exchanges prove in the most graphic manner. European exports to this country and elsewhere have not been of sufficient value to offset the demands for food and raw materials, and for the few capital goods which already have been shipped. The need, therefore, for a broad scheme of credit extension is more vital than ever."

Maryland-Virginia Utility Merger Approved.

Public Service Commission of Maryland, Baltimore, Md., has handed down its approval of the merger of a number of gas, electric light and power companies located in Maryland and West Virginia, the new corporation to be known as the Potomac-Edison Gas & Power Co., with headquarters at Grafton, W. Va. The properties to be taken into the merger are as follows: Grafton Light & Power Co.; Grafton Traction Co.; oil wells, plants and pipe lines of the Eastern Oil Co., Buffalo, N. Y.; Central West Virginia Gas Co.; West Virginia & Maryland Gas Co., operating in West Virginia and Maryland; a controlling interest in the capital stock of the Hartland Power Co., as well as the power plant electric light, traction and street car lines of the Cumberland Co., Cumberland, Md. Barstow & Co., 50 Pine street, New York, are interested largely in the new consolidation. It is said that the project is the largest in the history of the states of West Virginia and Maryland.

Local Utilities Merged.

It is announced that the Maryland Public Service Commission has handed down an order authorizing the merging of a number of local and nearby utility concerns. The companies affected are the Cambridge Gas, Electric Light & Power Co.; Salisbury Light, Heat & Power Co., both of Salisbury, Md.; Idlewild Electric Light, Heat & Power Co., Federalsburg; and the Peninsular Light & Power Co. into the Eastern Shore Gas & Electric Co. The new organization will issue stock for $315,000 in exchange for the aggregate stock of like amount of the merged companies.

Merger of Kansas City Companies Requested.

Application for the issuance of $9,998,000 in common stock and the flotation of $8,000,000 worth of bonds, has been filed with Missouri Public Utilities Commission by Kansas City Power & Light Co., Kansas City, Mo. Simultaneously, another application was filed by the Standard Electric Light Co., a Kansas City, Kan., corporation, for permission to transfer its plant and other property to the Kansas City Power & Light Co.

The merging of these two concerns will place much of the lighting and power for the Kansas City, Kan., industries, and residents in the hands of the Kansas City, Mo., firm. Extensive enlargements, improvements and service extension is contemplated by the corporation, according to the filing papers.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid Dec. 16.	Bid Dec. 23.
Adirondack Electric Power of Glens Falls, common	6	15	15
Adirondack Electric Power of Glens Falls, preferred	6	77	76
American Gas & Electric of New York, common	10+extra	123	118
American Gas & Electric of New York, preferred	6	39	38
American Light & Traction of New York, common	..	195	180
American Light & Traction of New York, preferred	6	92	91
American Power & Light of New York, common	4	63	63
American Power & Light of New York, preferred	6	73	73
American Public Utilities of Grand Rapids, common	..	8	7
American Public Utilities of Grand Rapids, preferred	7	21	21
American Telephone & Telegraph of New York	..	99⅛	..
American Water Works & Elec. of New York, common	..	2	2
American Water Works & Elec. of New York, particip	7	6	4
American Water Works & Elec. of New York, first preferred	..	45	35
Appalachian Power, common	..	3	3
Appalachian Power, preferred	7	20	20
Cities Service of New York, common	+extra	402	405
Cities Service of New York, preferred	6	72	72
Commonwealth Edison of Chicago	8	107	..
Comm. Power, Railway & Light of Jackson, common	..	20	19
Comm. Power, Railway & Light of Jackson, preferred	6	..	39
Federal Light & Traction of New York, common	..	7	7
Federal Light & Traction of New York, preferred	..	42	41
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	..	20
Middle West Utilities of Chicago, preferred	6	..	43
Northern States Power of Chicago, common	..	63	63
Northern States Power of Chicago, preferred	ex.div.7	89	89
Pacific Gas & Electric of San Francisco, common	..	60	60
Pacific Gas & Electric of San Francisco, preferred	6	..	..
Public Service of Northern Illinois, Chicago, common	7	78	75
Public Service of Northern Illinois, Chicago, preferred	6	89	85
Republic Railway & Light of Youngstown, common	4	12	10
Republic Railway & Light of Youngstown, preferred	6	46	40
Standard Gas & Electric of Chicago, common	..	27¼	27½
Standard Gas & Electric of Chicago, preferred	6	41	40¼
Tennessee Railway, Light & Power of Chattanooga, common	..	2	2
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5	6
United Light & Railways of Grand Rapids, common	4	..	..
United Light & Railways of Grand Rapids, preferred	6	60	57
Western Power of San Francisco, common	..	21	20
Western Union Telegraph of New York	extra	87	87⅛
Industries.			
Electric Storage of Philadelphia, common	4	132½	132
General Electric of Schenectady	8	166	169
Westinghouse Electric & Mfg. of Pittsburgh, common	7	52⅜	53⅜
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	..	..

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Managing Editor.

FRANK A. MERKEL,
Advertising Manager.

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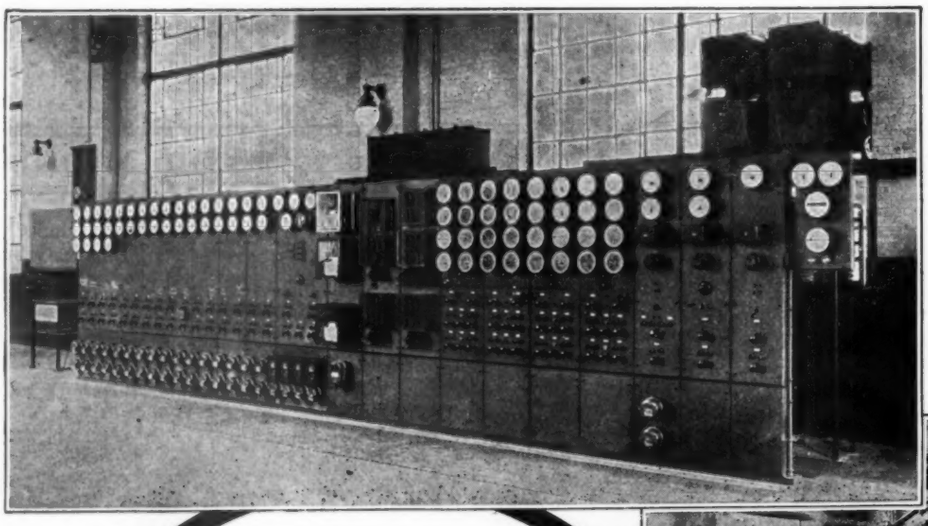
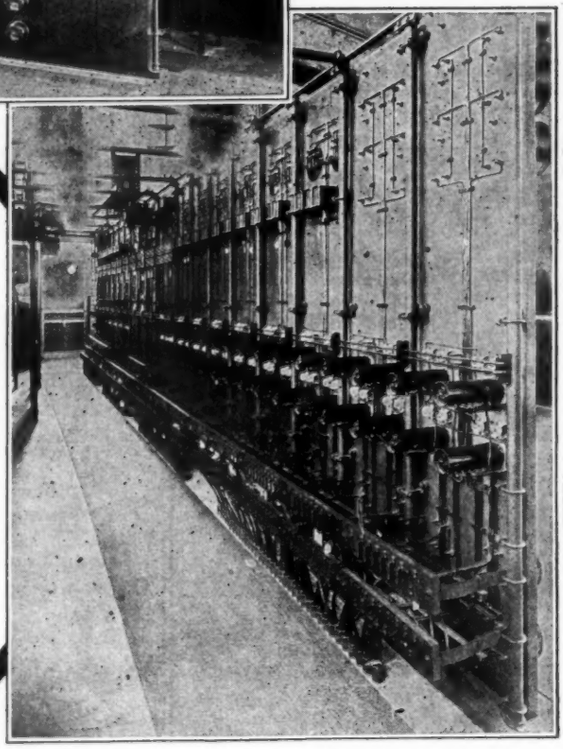
A Typical Electrically Operated Westinghouse Switchboard

In a Large Industrial Plant in the Middle West





The switchboard controls eight 430 kv-a, 2300-volt, 3-phase, 60-cycle Generators; two 130 kw. and one 100 kw., 125-volt Exciters; thirteen 2300-volt Feeders; and two 2000 kv-a Incoming Lines

Of particular interest is the large Type AH-34 Westinghouse Generator Voltage Regulator mounted on two 16-inch panels in the center of the board.

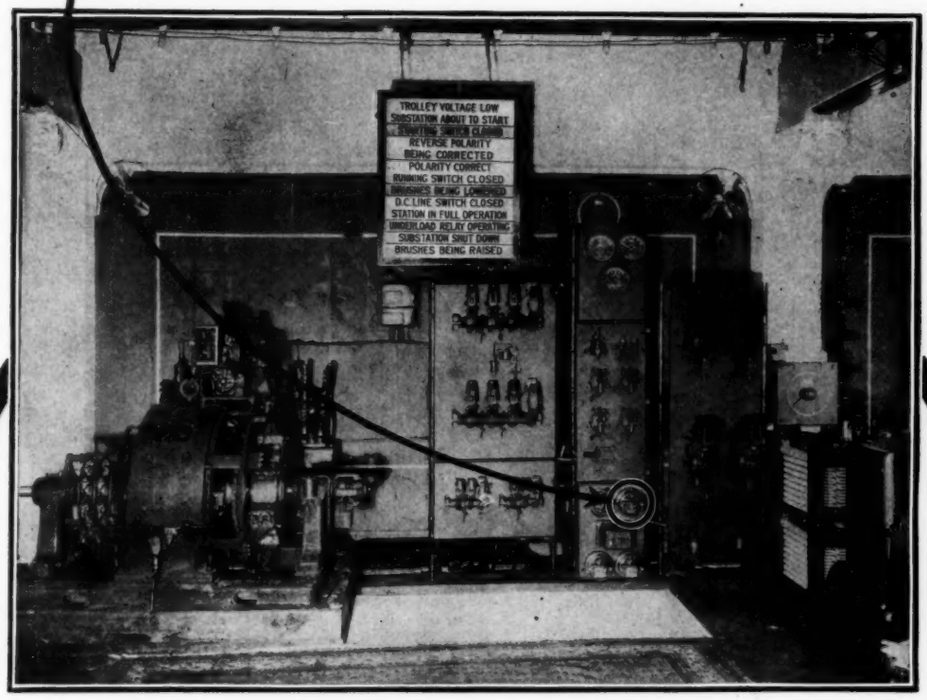
The compact and neat appearance of the Type CS Oil Circuit Breakers Controllers is well illustrated on the front and rear views of the board.

W
WESTINGHOUSE ELECTRIC

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse

The Reverse Phase and Low Voltage Relay protects the machine from transposition of line connections, low voltage of all phases, and from failure of any phase.



The relay constitutes one of the most important of the many protective devices embodied in the Westinghouse Automatic Substation. It is a standard induction relay which is used extensively by most of the large operating companies. Write for Descriptive Leaflet No. 3998-A.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

W
WESTINGHOUSE ELECTRIC

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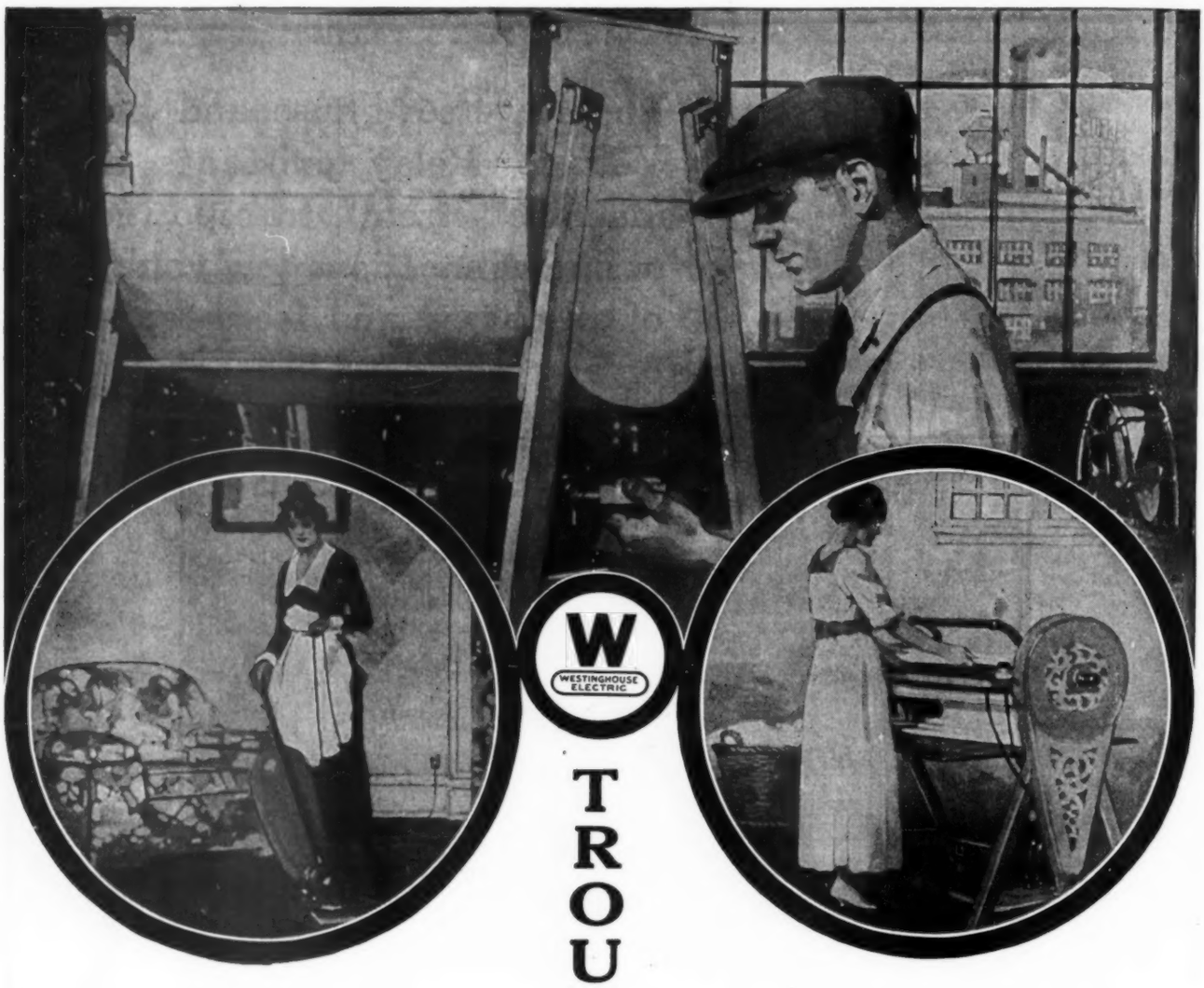


TROUBLE PROOF

In recent advertisements we have told you WHY the Westinghouse Small Motor IS trouble-proof. These trouble-proof features were referred to as Points of Superiority in Westinghouse Small Motor Construction.

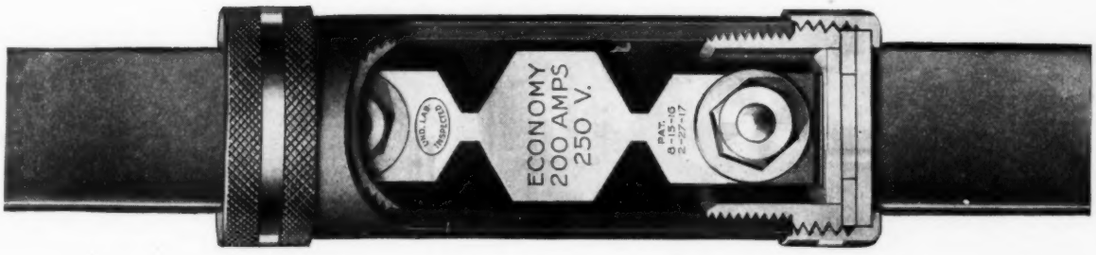
The superior points of design, combined with our familiarity with the problems usually met with in the different appliance fields, guarantees that high degree of operating dependability that every progressive appliance manufacturer must insist upon.

Have you a copy of our new Circular No. 7300 describing the Westinghouse Trouble Proof Motor in its various applications? If not, send us your name and address.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
East Pittsburgh, Pa.

Westinghouse

ECONOMY FUSES



The only "Approved-in-All-Capacities" renewable fuse using inexpensive bare renewal links for restoring a blown fuse to its original efficiency.

December 9, 1919, ECONOMY renewable FUSES, in ALL CAPACITIES, from 0 to 600 Amperes in both 250 and 600 Volts were approved by the UNDERWRITERS' LABORATORIES, established and maintained by the NATIONAL BOARD of FIRE UNDERWRITERS, and now bear the label "Und. Lab. Inspected." ECONOMY "Drop Out" Renewal Links also bear the inspection symbol.

In your future purchases of enclosed fuses be sure to insist that both the fuses and the renewal links, IN ALL CAPACITIES, bear the inspection symbol.

ECONOMY "Drop Out" Renewal Links made approval possible for renewable fuses.

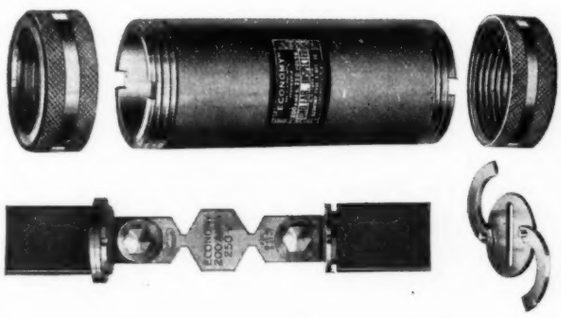
Millions in use for many years.

Ask for and insist upon ECONOMY renewable FUSES and the famous Economy "Drop Out" Renewal Links.

ECONOMY FUSE & MFG. CO.

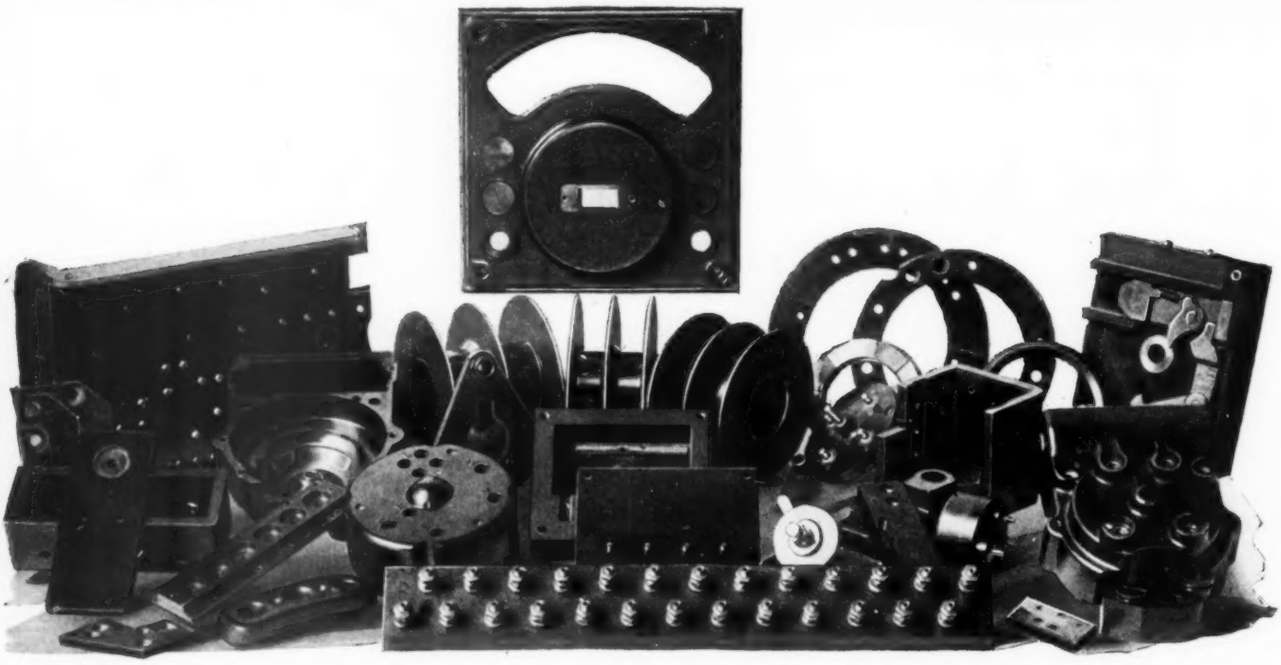
Kinzie and Orleans Streets, CHICAGO, U. S. A.

ECONOMY FUSES ARE ALSO MADE IN CANADA AT MONTREAL



The Improved ECONOMY Renewable FUSE

Study the renewable link feature. See the two narrow bridges of metal holding the "Drop Out" features in place. In operation on short circuits, these two bridges fuse. The entire fuse metal does not volatilize, only the two narrow bridges. This very greatly decreases the danger factor due to the tremendous pressure generated when an entire strip of fusible metal is instantly converted into gases. No powdered filler to deteriorate or solidify. Only the fuse metal is destroyed; the fuse itself is ready for years of service. See the new winged washer which makes it simple and easy for anyone to replace the "Drop Out" Renewal Link in a few minutes.



Moulded Insulation—

IT is actual experience that makes us unbiased on the subject of Moulded Insulation. We realize that no one, or two, or three types can hope to cover every requirement.

Because the factors that govern the choice of Moulded Insulation are as varied as the demands of the electrical industry. So, for many years, we have been making Moulded Insulation with only one purpose in view—to meet existing conditions.

Whatever kind of compound is indicated—whether mica, asbestos or wood filler—shellac, phenol, rubber or any other base—we are prepared to furnish it in a form that will fill your needs.

And, because of our production facitities, we can make attractive prices and very prompt deliveries.

May we send you descriptive literature or quotations?

H. W. JOHNS-MANVILLE CO. *New York City*

10 Factories—Branches in 63 Large Cities

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Asbestos

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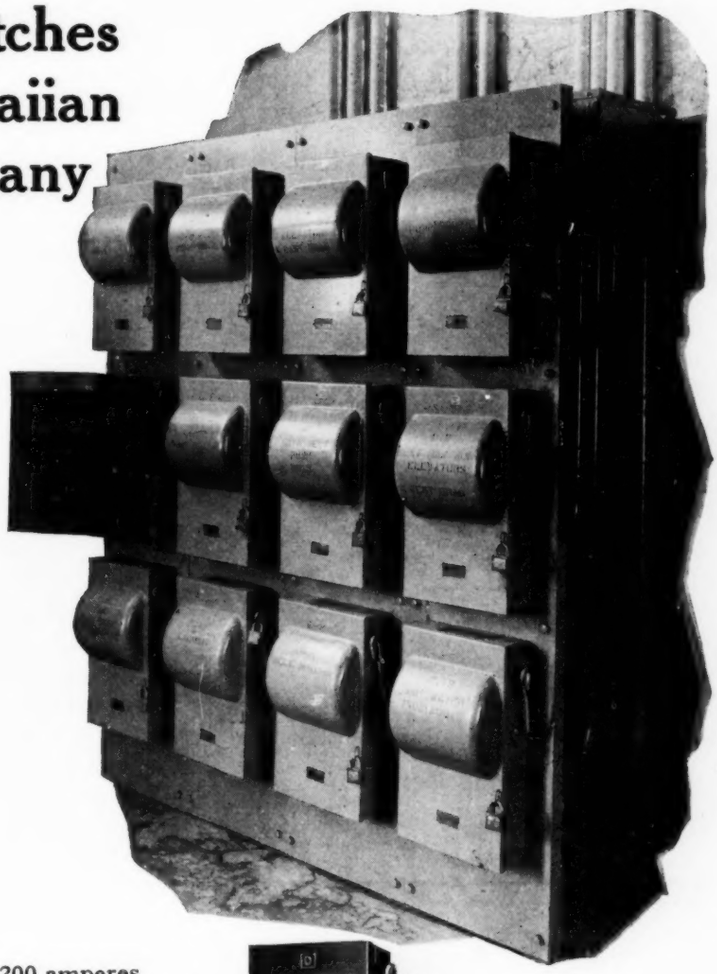
JOHNS-MANVILLE ELECTRICAL MATERIALS

Square D Safety Switches for California & Hawaiian Sugar Refining Company



IT is interesting to note the type of organizations that install Square D Safety Switches.

Wherever you find Square D Safety Switches, there you will find an organization that regards the safety, contentment and happiness of its employees as of vital importance. And there, too, you will find an institution that wants nothing short of the best—in safety switches as well as in any other equipment or material.

Careless or ignorant hands and arms cannot come in contact with the live parts of the Square D Safety Switch—it is completely enclosed within a pressed steel box and operated by an outside handle. Cover of switch box can be locked. And the Square D Switch can be locked in the "off" position when work is being done on the line.

Made in two-, three-, and four-pole types in standard voltages of 125, 250, 500 a.c. and 600 volts, in capacities from 30 to 1200 amperes. Over 300 types and models.

Listed as standard for fire and accident prevention by the Underwriters' Laboratories of the National Board of Fire Underwriters. Meet the requirements of the National Electrical Safety Code of the Bureau of Standards.

No matter what your connection with the electrical industry, write for literature on the Square D Safety Switch today. We will promptly send you complete information.

SQUARE D COMPANY, *Detroit, Michigan*

Canadian Works: Walkerville, Ont.

New York Chicago Philadelphia Pittsburgh Atlanta St. Louis
San Francisco Portland, Ore. Cleveland Toronto, Ont.

Square D Safety Switch

AMERICAN BRIDGE COMPANY

HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

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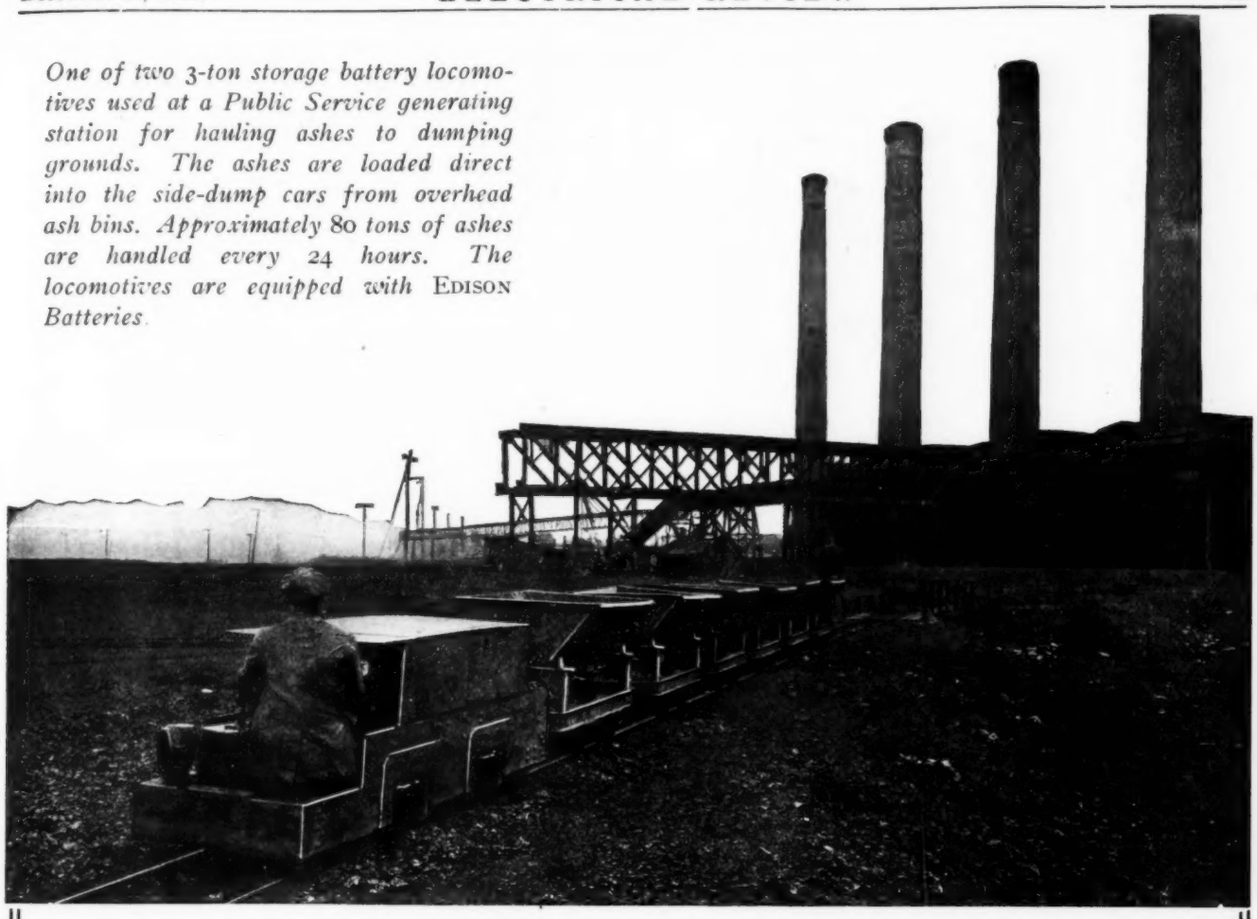
You're Missing Something

If you do not watch the International Clearing House Section which appears in every publication of the International Trade Press, Inc.

Through this section you can buy, sell, rent or exchange all classes of equipment and material. Through it you can get in touch with prospective employees or locate a new position. If you need additional distribution for your product, it will help you locate capable sales representatives or agencies to handle it.

Get acquainted with the Clearing House. Read it regularly and then file it away for reference. Remember it's the easiest way to get what you want and to sell what you don't need.

One of two 3-ton storage battery locomotives used at a Public Service generating station for hauling ashes to dumping grounds. The ashes are loaded direct into the side-dump cars from overhead ash bins. Approximately 80 tons of ashes are handled every 24 hours. The locomotives are equipped with EDISON *Batteries.*



Storage Battery Locomotives

used in

Power and Industrial Plants, Lumber Yards, Etc.,

for handling

Ashes, Waste Materials, Lumber, Coal, Etc.

The storage battery locomotive is especially adapted to the heavy haulage needs of power plants, foundries, mills, coal and metal mines, lumber yards, etc. They release many men for more productive work and thus help to overcome the shortage of high-priced labor.

Fire risk is reduced, for these locomotives can go in many places where smoke, fumes hot cinders or exhaust gases forbid other means. They are dependable, safe and economical. Unskilled labor can operate them.

This service is hard and rough for batteries—it takes the steel-and-iron construction of the EDISON cell to stand up, year after year. EDISON cells are standard for this work, they give highest service efficiency.

Bulletin 608-P, "Edison Storage Batteries for Storage Battery Locomotives," on request.

EDISON STORAGE BATTERY COMPANY

Factory and Main Office: ORANGE, N. J.

Distributors in

New York Boston Chicago Detroit San Francisco Seattle
Los Angeles New Orleans Pittsburgh Kansas City
Washington Philadelphia Cleveland Denver
Atlanta Syracuse Scranton New Haven

WHEN YOU INSTALL A HARTFORD TIME SWITCH

you eliminate the human element.

"Just wind it once a week" and your signs will be controlled as you wish.

ASK YOUR JOBBER

THE HARTFORD TIME SWITCH CO.

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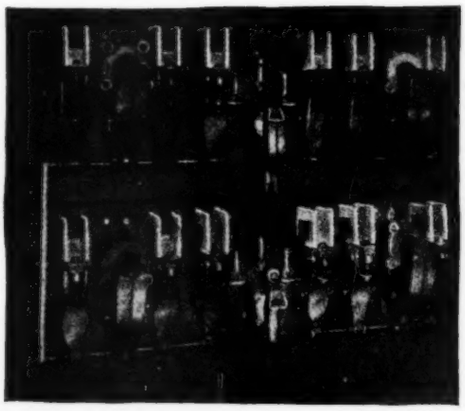

SUNDH Can Solve Your Problem

Just As This One Was Solved

Two electrical sources were available—a main source and an emergency source. Both sources were to be used at all times for portions of the service. Provision had to be made for the utilization of one source for the total requirements in the event that the other source failed.

The SUNDH equipment automatically provides for the consumption of precisely the amount of Central Station energy contracted for, while also insuring the automatic switching of the entire load into either source of supply should the other source fail.

The value of such equipment cannot be overestimated. Let SUNDH SOLVE YOUR PROBLEM.

SUNDH ELECTRIC COMPANY
Ave. C and Parkhurst St., Newark, N. J.
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First National Bank, Pittsburgh, Pa.
H. J. Kaufman, Peoples Gas Bldg., Chicago, Ill.

KUHLMAN TRANSFORMERS

Rest their case not on what is claimed for them but on their magnificent actual record for the last twenty-five years.

Made by a firm of transformer specialists with an organization of specialized workmen.

The correctness of their design and thorough testing make their performance a certain quantity.

Write for the KUHLMAN bulletins.

KUHLMAN ELECTRIC CO.
Bay City, Mich.

The Motors You Buy

—are they fitted to their tasks?

To give satisfaction, your motors must be fitted to the particular task they perform — makeshifts never are successful.

COLONIAL

Motors are made for every motor use. There is a size and type for every drive. Bulletins on request.

THE COLONIAL FAN & MOTOR CO.
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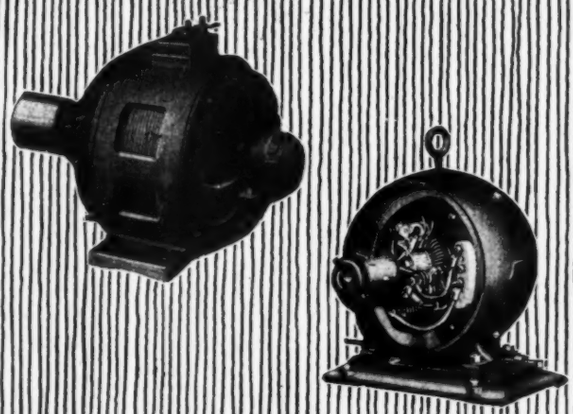
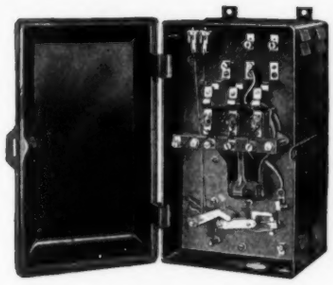


A. C. STARTING SWITCH
TYPE ZB



FOR STARTING SMALL INDUCTION MOTORS

WHAT THEY SAY

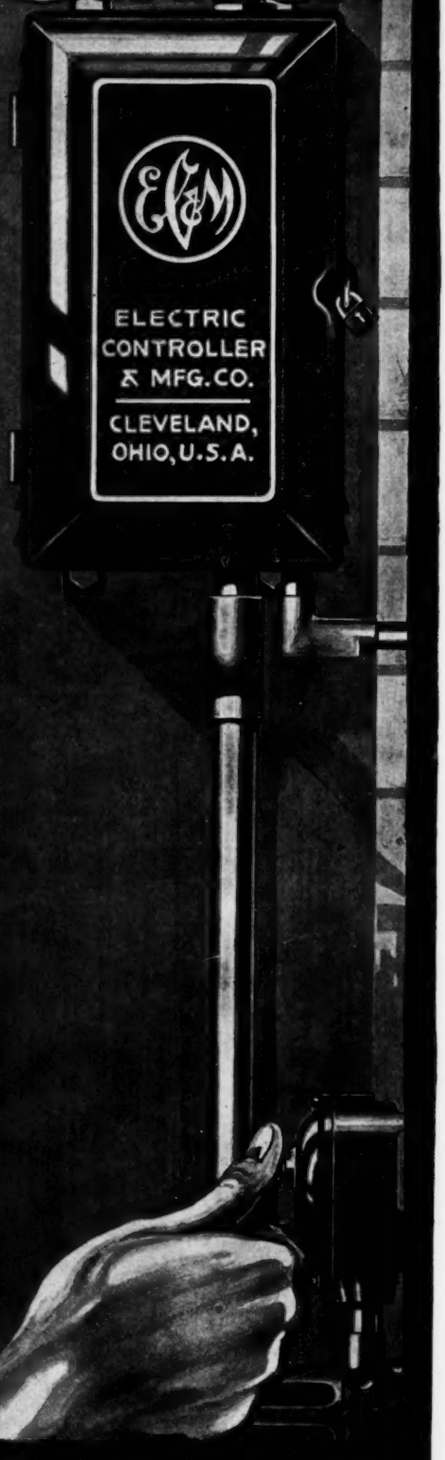
A large manufacturer of Automobile parts says:

"We take pleasure in stating that the ZB Motor Starter has proven very satisfactory in every respect, performing all the duties claimed for it by the manufacturer.

Believing that this type of starter will pay for itself in a very short time, have recommended that these be installed on all of our motors for 5 HP and under."

WHAT WE CLAIM

Remote Control.
Overload Protection.
Lost Phase Protection.
Safety from shocks or burns.
Inverse time element overload without dash pots.
No laminated parts.



THE ELECTRIC CONTROLLER & MFG. CO.
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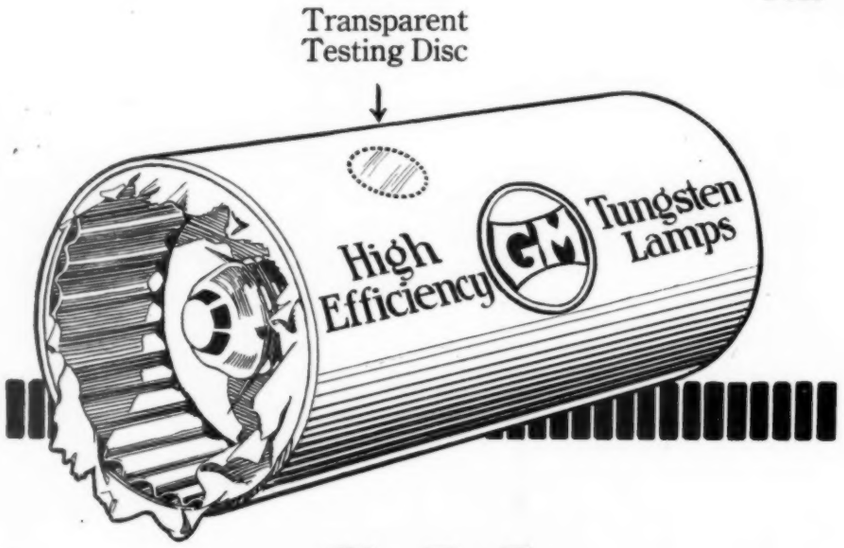
All Sizes
All Types



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High Efficiency Tungsten Lamp

From the Dealer's View Point

Packed in an ingenious, strong carton that contains no excelsior, with its attendant fire risk, and that occupies one-third less space.

You can test every G-M Lamp without disturbing its wrapper.

The G-M High-Efficiency Tungsten Lamp is a product of expert engineering and rigid laboratory tests—one of the few lamps in the country so backed.

Flat discounts, allowed on order, permit full earnings from the start. Write for schedule of prices and discounts.

Lord Manufacturing Company

Incorporated 1905
Electrical Distributors

105 West 40th Street, New York

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Address All Communications To Main Office

A better plug for a double purpose:

Your machine—in the retail store. Listen!

WOMAN: "Yes, I like it very much, but will that plug fit a wall plate? My vacuum cleaner has only the twisting kind, and it's a perfect nuisance. I have to screw it into a lamp socket every time, whereas if I had the other kind of plug I could use our wall plates, you know."

SALESMAN: "I'm glad you mentioned that, madam, because it is very important. This plug is a Hubbell. It has two parts, the body which screws into any lamp socket, and the cap which plugs into any wall receptacle or current tap. You can use this in any part of the house; it's a better plug for a double purpose."

WOMAN: "Oh, I'm so glad—then I'll take the machine. And can you sell me one of those plugs? I'll have my husband put it on our vacuum cleaner. Thank you."

This is a Hubbell Composition Attachment plug No. 5467 with Edison Base. Cap has Tandem blades. Contacts are made separate arcing chambers, preventing shock or short-circuiting.

Send for the Hubbell Catalog

HARVEY HUBBELL INC
ELECTRICAL SPECIALTIES
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2035-U

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Smooth Case

Corrugated Case

Pressed Steel Case Pittsburgh Transformers

The Pressed Steel Case was originated in 1913 by the Pittsburgh Transformer Company. It was the first in the field—it retains the leadership today.

The Pittsburgh Pressed Steel Case has successfully come through every stage of development. It has long ceased to be an experiment—thousands have been in service for the past six years.

Pittsburgh Transformer Company

Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pa.

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"National"

Inter-connecting Metal Moldings

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TWO WIRE ONLY

333
THREE AND FOUR WIRE

FOR YEARS THE STANDARD FOR

Surface Wiring

Economical and Easy to Install

Stocked by All Leading Jobbers

Safe and Sightly

Write for Descriptive Bulletin 101 and Installation Chart

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Canadian Distributors: Canadian General Electric Co., Ltd.

You could be making a good profit on DENZAR right now, as so many other dealers are doing

There never was a time when people were so interested in better lighting for offices, stores, schools, factories and public buildings. Wise dealers are taking advantage of this widespread interest and are making it pay them a profit. And there *is* a real profit in this business. Every bit of work you put in on DENZAR brings its results—helps to build up a permanent and highly profitable business for you.

It's easy to sell DENZAR

If you haven't tried it, you'll be surprised to see how easy it is to sell DENZAR. People who are interested in securing better illumination can see its points of superiority as soon as you explain them. It sells practically on sight.

You can't afford to overlook the profits you can make on DENZAR. Write now for the DENZAR catalog and details of our very liberal terms to established dealers.

Beardslee Chandelier Mfg. Co.

Manufacturers of a Complete Line of Chandeliers for Every Lighting Requirement.

220 South Jefferson St. CHICAGO

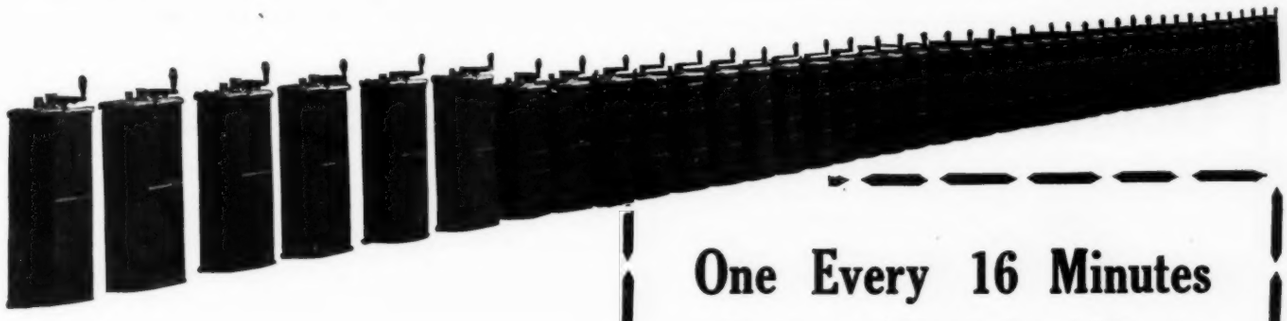
40 Years of Repeat Orders Is Convincing Proof

For 40 years telephone and telegraph companies have been buying Oshkosh Construction Tools. The fact that more than half of all the telephone and telegraph companies in America have been built with Oshkosh Tools is ample proof of the regard in which they are held. *Your jobber handles them.*

OSHKOSH MANUFACTURING CO.
522 Review St. OSHKOSH, WIS.

OSHKOSH

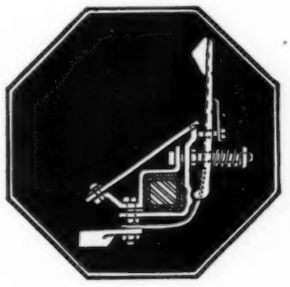
Construction Tools



C-H

DRUM CONTROLLERS

With the Well Known C-H Contact Fingers



One Every 16 Minutes

Over 10,000 of this one class of C-H motor control apparatus, namely, C-H Drum Controllers, were shipped out during the past 12 months' period alone.

Nearly a half million horsepower is the capacity in service.

Several factors have made C-H Drum Controllers practically the only ones considered for crane, hoist, conveyor and various kinds of mill and industrial work.

1. **The C-H Non-stubbing Finger.**
2. **Accessibility of parts—easy removal of entire finger unit and segment cylinder.**
3. **Interchangeability due to standardized parts.**
4. **Smooth movement with definite indication of control points.**
5. **The thoroughness of C-H Workmanship.**

In fact, a C-H drum controller is what maintenance men call "a regular, husky piece of apparatus;"—fine to operate and fine to take care of.

Pub. 461 has rating and dimension data and will be sent on request.

The Cutler-Hammer Mfg. Co.

New York: Hudson Terminal, 50 Church St. Chicago: Peoples Gas Bldg. Pittsburgh: Farmers' Bank Bldg. Boston: 77 Franklin St. Philadelphia: Commonwealth Bldg. Cleveland: Guardian Bldg. Cincinnati: Gwynne Bldg. Detroit: 905 Kresge Bldg., H. B. Squires Co. San Francisco: 583 Howard St. Los Angeles: 206 So. San Pedro St. Seattle: 552 First Ave. So. General Machinery Co., Birmingham, Ala., Brown-Marx Bldg.

Works: New York and Milwaukee

CUTLER-HAMMER

World's Largest Manufacturer of Electric Control Apparatus

GETTING FULL VALUE FROM EVERY MINUTE

Western Electric
INTER-PHONES

Nowadays when everyone is confronted with the necessity of getting full value out of every minute, such a time-saver as the Western Electric Inter-phone is practically indispensable to the central station, electrical manufacturer and electrical shop.

The real value of using a Western Electric Inter-phone system is that it not only saves time for you and the other executives, but that it will save many minutes each day for every member of your organization.

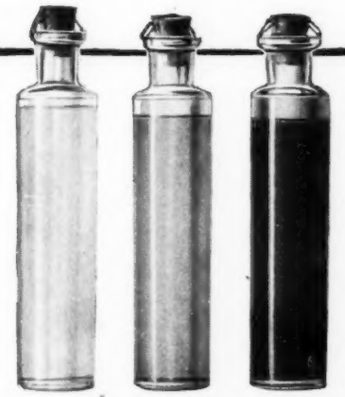
The Inter-phone stands for instantaneous communication. Instead of sending a messenger to find the man to whom you wish to speak and then waiting until he reaches your office, you just pick up the receiver on your Inter-phone, and press the ringing button. Instantly he replies and you can speak your message or give instructions that carry the force of your personality.

The Inter-phone is economical—neither switchboard nor operator is required since the user makes his own connection. Western Electric Inter-phone Systems are available for use in the largest plant or in the smallest shop.

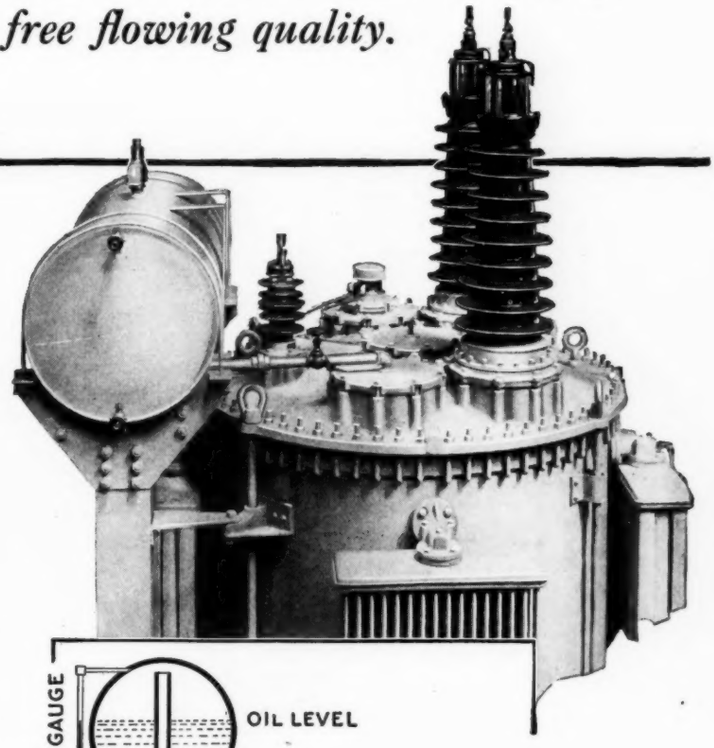
For more detailed information, consult the telephone engineers at our nearest house.

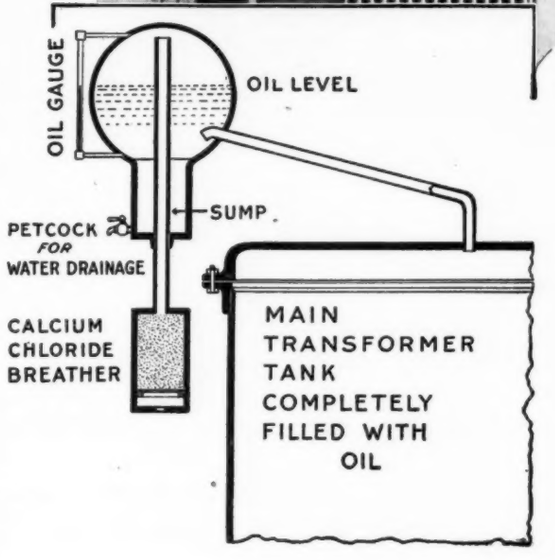
Western Electric Company
INCORPORATED
Offices in All Principal Cities

The Oil Conservator preserves the dielectric strength of transformer oil and its free flowing quality.



oil before being used | used with conservator | used without conservator





The Oil Conservator Transformer as developed by the General Electric Company consists of a main tank, containing the transformer, which is completely filled with oil, and an auxiliary tank for oil expansion. Connection between the two tanks is restricted so that there is no rapid interchange of oil and the temperature of the oil in the auxiliary tank is always relatively low. Any water that may be condensed in this auxiliary tank is collected in a "sump" and drawn off without coming in contact with the transformer, and main body of the oil.

What the Oil Conservator Transformer does

I. Eliminates "Breathing" and water condensation in main tank, thus maintaining the original insulating value of the oil.

II. Avoids the possibility of explosion by the ignition of a mixture of air and gas vapor from hot oil.

III. Practically eliminates oil decomposition or "sludging" as a result of exposure of hot oil to oxygen.

The General Electric Company offers the Oil Conservator Transformer as a standardized product with its value already fully established in the field and a factory equipment allowing of its economic application to practically all oil insulated "power" units of 500 Kv-a capacity and above.

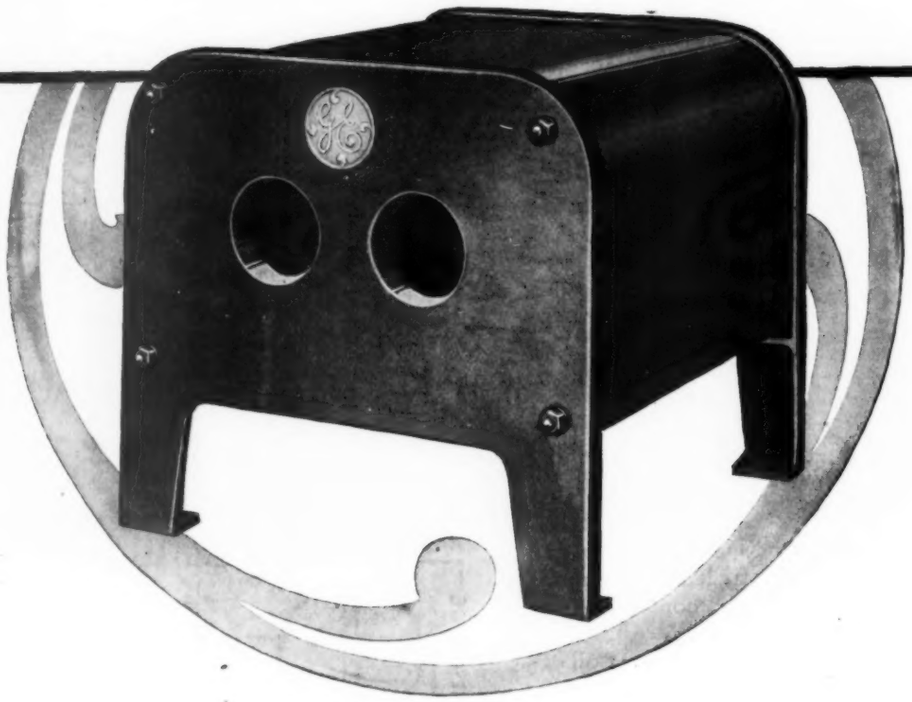
General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

51-5

Modern Industries are profiting by keeping abreast of the rapidly advancing use of Electric Heat



The Electric Soldering Iron Furnace for Moderate and Heavy Duty Work

The electrically heated furnace will heat your irons evenly without the constant attention of an operator.

Operates any commercial circuit of 110 or 220 volts.

The elimination of fuel with its excessive heat and noxious fumes will increase production and reduce fire risk.

Improve the working conditions in your factory by installing G-E soldering iron furnaces.

Bulletin on request.

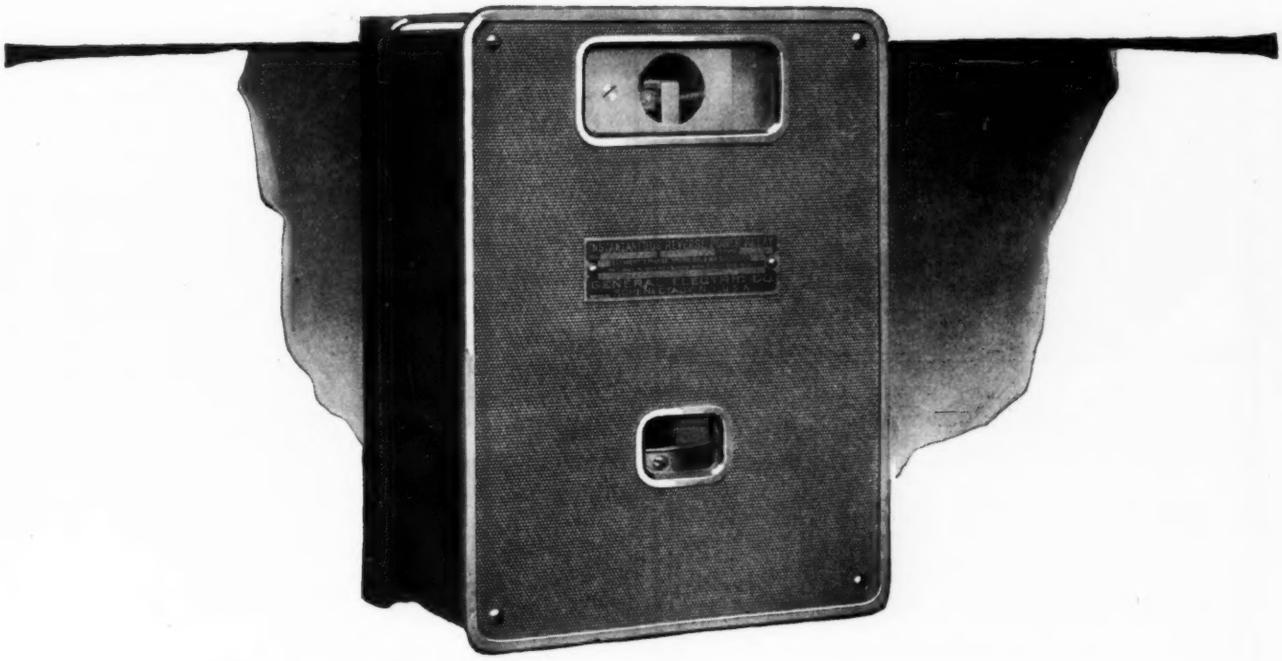
The electric way is the modern way—the proven, economical way.

39-29

General Electric Company

General Office Schenectady, N.Y.

To secure the greatest benefits from applications of electricity, foresight demands proper control and protective devices.



The G-E, IK-4 Polyphase Induction Reverse Power Relay

THE name indicates the protection this relay affords. The G-E, Type IK-4 Polyphase Induction Reverse Power Relay acts instantly or with a time delay depending on the characteristics of the overload relay in series with it.

The G-E, IK-4 will operate correctly

—on practically all single-phase short circuits, even if the voltage between the two lines that are short circuited falls to zero,

—on balanced three-phase short circuits with 10 amperes secondary and one per cent. of normal, remaining,

—on practically all balanced short circuits, even with the voltage as low as one per cent. of normal.

By the construction of this relay, any incorrect tendency on one phase is balanced by a similar incorrect tendency on some other phase. The true power direction will control the operation.

Consult the G-E Relay Specialist in your locality.

Write our nearest office.

G-E Reverse Power Relays

General Electric Company

General Office Schenectady, N.Y.

54A-25

Model 341 Portable A. C. and D. C. Voltmeter

Weston **Electrical Indicating Instruments**

are unqualifiedly superior to any other instruments designed for the same service. A. C. or D. C. Switchboard or Portable Instruments for every field of Indicating Electrical Measurement.

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Low cost of installation and maintenance make them desirable from an investment standpoint. Streets need not be torn up; pipes, manholes and catch basins need not be moved, and no conduit is required.

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
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The No. 328 SIMPLEX Pole Pulling and Pole Straightening Jack

By pulling and straightening poles in a fraction of the time and with one-third of the men required to do the work in the usual way, this exclusive Simplex tool has established a record for economy and efficiency heretofore unattainable in this work. Adopted as standard equipment by hundreds of Telephone Companies.

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Splicing -TAPE- Friction

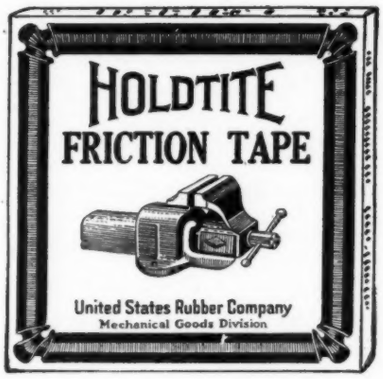
THERE is not a better or more favorably known black Friction Tape manufactured than Holdtite. It is heavily coated on both sides with a high grade compound, and is recommended for general electrical work.

Utility Friction Tape is recommended for use wherever a thin tape is desired. It is coated on both sides with a black compound. Durable for either outside or inside work, or for telephone work.

United States Friction and Splicing Tapes meet every requirement. All are highly dielectric, contain no free sulphur and keep their original good qualities.

United States Tapes
are Good Tapes

United States Rubber Company



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Why consider the destructible when you can have the indestructible?

No matter how badly crushed, twisted or kinked, "Loomflex" can always be pinched back into shape and used.

Easy to fish. All sizes are slightly oversized and there are no seams to break loose. The roller-bearing construction of the interior allows the wires to slide through with a minimum of friction.

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American Circular Loom Co.
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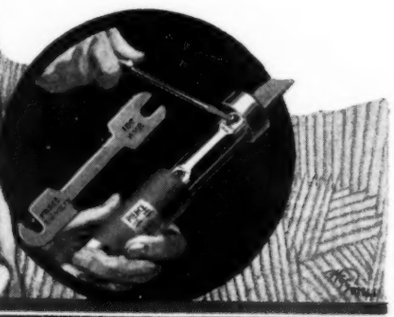
Renewed just as easily as closing a transom—in 15 seconds—Pierce Fuses make interruptions unnecessary in your production work.

Let us send you literature describing in detail the unusual features of Pierce Fuses.



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RENEWABLE FUSES

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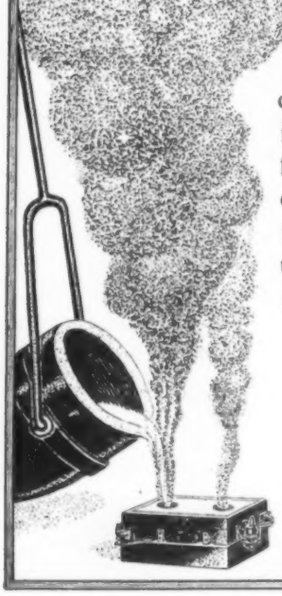

will withstand the corrosive gases met with in many industrial plants, thus making it particularly valuable for coils of motor generators, and other electrical apparatus used under extremely adverse conditions.

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(First-class Used)

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2—Batteries, 750 hp. each, consisting of one 500-hp. and one 250-hp. Keeler horizontal water-tube boilers, 160-lb. working pressure. Complete, including fronts, trim, grates and guyed steel stack for each battery, 500-hp. Foster superheater. Age 2½ years.
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2—72x18 H.R.T. boilers, suspended type, 125 to 150 lbs., overhauled, seams butt-strapped, quad. riv. Shells ½ in. Heads 9/16 in. Firebox steel.

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1—1000-kw. Westinghouse Turbo-Gen. Set. 2300-v., 60-cyc., 3-ph. with LeBlanc jet condenser and auxiliaries.
2—500-kw. G. E. Vertical Turbo-Gen. Sets. 2300-v., 60-cyc., 3-ph. (condenser and auxiliaries if required). Good for standby for hydro plant. Price $2,500.00 each. Subject to prior sale.
1—500-kw. Engine Gen. Set. 2300-v., 60-cyc., 3-ph.
1—300-kw. Engine Gen. Set. 250-v., DC.
1—150-kw. Engine Gen. Set. 250-v., DC.
1—400-kw. Motor Gen. Set. 250/275-v., DC. Gen. 2300-v., 60-cyc., 3-ph. motor.
2—100 kw. Motor Gen. Set. 250/275-v., DC. Gen. 2300-v., 60-cyc., 3-ph., motor.

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2—2000 sq. ft. Worthington Surface Condensors. Complete with all pumps, dry vacuum pumps and pipe, valves and fittings. All in excellent condition.
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A.C. Switchboard Panels, New, 1912. Spec. Westinghouse and G. E., 2300-v., 60-cyc., 3-ph., 16 panels, 2-in. Blue Vermont Marble, each built one section 32-in.x62-in. and one section 32-in.x28-in., including latest type rding watt-meters and other standard switch-instruments; oil switches; indicating and recoswitchboard equipment, horizontal edgewise board apparatus.

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4 200-amp. Integrating Watt-Meters.
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What you become in the electrical industry and how much you may eventually earn is mainly up to you. Many of the big electrical engineers of today have been my pupils.

I will help you whenever the opportunity presents itself. That statement is broad, but I make good on it in every particular.

No advance payments—should you discontinue the course, your payments stop. The course must prove satisfactory.

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My business is run on a fifty-fifty basis. That is, I am just as much concerned with my student's welfare and progress as I am with the money he sends me, and that I meet him half way on any proposition. I offer nothing free, give nothing free and do not expect anything unless I return its full value.

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The above Units are in absolutely A1 condition throughout and will be so guaranteed by us. Immediate delivery can be made.

A. C. and D. C. Units,
Boilers, Engines,
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60 Cycle	2200 Volts
400 R.P.M.	Type E.M.V. 65

These motors are three pedestal type equipped with pulley and rails.

Two SUNDH Automatic Starters
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Kw.		Speed.
1—15	Garwood 3-wire d. c. to De Laval turbine.	
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1—25	Fairbanks Morse	725
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60—	¼	H.P.	1200 R.P.M.	17.75 each
32—	½	H.P.	1200 R.P.M.	26.50 each
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4—	1	H.P.	1700 R.P.M.	38.75 each
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3—	7½	H.P.	1200 R.P.M.	140.00 each
5—	10	H.P.	1700 R.P.M.	140.00 each
5—	10	H.P.	1200 R.P.M.	160.00 each
4—	15	H.P.	1200 R.P.M.	190.00 each
2—	10	H.P.	850 R.P.M.	195.00 each
3—	20	H.P.	1200 R.P.M.	245.00 each
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Largest stock in America.

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Motor Generator Wanted

One or two motor generators, for 110-125 volt direct current, 25 or 30 K. W., 2 phase, 4 wire, A. C. drive of 220-440 volts, Quote best cash price and state where can be seen.

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No.	PP.	RPM.	Wdg.	Type.	Make.
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1	3	1200	Sh.	MP	Fidelity
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1	6	750/1500	Sh.	SK	Westinghouse
1	10	1180	Cp.	S	Westinghouse
3	10	1180	Sh.	S	Westinghouse
1	15	1000	Sh.	S	Westinghouse
1	15	1000	Cp.	S	Westinghouse
1	17½	585	Sh.	A-14	Gibbs
1	20	650	Sh.	MP	Northern
1	20	650	Sh.	MP	Milwaukee
1	20	600	Sh.	P	W. E.
1	20	900	Sh.	MP	Hobart
1	20	800	Sh.	MP	Imperial
1	20	1025	Cp.	S	Westinghouse
1	20	975	Cp.	S	Westinghouse
1	25	975	Sh.	MP	Northern
1	36	925	Cp.	S	Westinghouse
1	40	675	Sh.	MP	Northwestern
1	40	920	Cp.	MP	Jenny
1	40	800	Sh.	MP	Northern
1	40	700	Sh.	RC	G. E.
1	55	575	Cp.	E6½AOR	W. E.
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1	65	750	Sh.	S	Westinghouse

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All New, 3-Phase, 60-Cycle.

No.	HP.	RPM.	Volts.	Type.	Make.
3	100	720	220 or 440	AN	Allis-Chalmers
1	100	720	2200	AN	Allis-Chalmers
5	100	900	220 or 440	AN	Allis-Chalmers
1	150	720	2200	AN	Allis-Chalmers
1	150	900	220 or 440	AN	Allis-Chalmers
1	200	720	220 or 440	AN	Allis-Chalmers

ALTERNATING CURRENT MOTORS.
Slip Ring, 3-Phase, 60-Cycle.

No.	HP.	RPM.	Volts.	Type.	Make.
3	100	900	220 or 440	ANY	Allis-Chalmers
2	100	720	220 or 440	ANY	Allis-Chalmers
2	150	900	220 or 440	ANY	Allis-Chalmers
1	150	900	2200	ANY	Allis-Chalmers
3	150	720	220 or 440	ANY	Allis-Chalmers
2	150	720	2200	ANY	Allis-Chalmers
2	200	720	2200	ANY	Allis-Chalmers

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If replies are in care of this office, allow five words for the address.

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ENGINEER—MARRIED, AGE 29, WITH ten years' of practical experience in installation and maintenance of all kinds of A. C. and D. C. generators and motors, high and low tension line construction, switchboards, and all kinds of light and power wiring. A man who can get results, is looking for an opportunity anywhere in the United States. Address Box 3357, % Electrical Review, Chicago, Ill.

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LINEMEN—STEADY POSITION WITH utility company within 50 miles of Chicago. Address Box 3356, % Electrical Review, Chicago, Ill.

WANTED — METER DEPARTMENT manager for company with 50,000 electric consumers. Salary $100 per month. Address Box 3355, % Electrical Review, Chicago.

LARGE PUBLIC UTILITY IN MIDDLE west requires services of electrical draftsman for power plant and substation work. State age, experience and salary desired. Address Box 3358, % Electrical Review, Chicago, Ill..

FOR SALE

D. C. GENERATORS FOR SALE—1 100 kw., 360 rpm., 125 volt, belted. 1 60 kw., 275 rpm., 125 volt, engine type. 1 60 kw., 275 rpm., 250 volt, engine type. All General Electric, in excellent condition, for immediate delivery. V. M. Nussbaum & Co., Fort Wayne, Ind.

A. C. GENERATORS FOR SALE—62½ kw., 900 rpm., 3 phase, Electric Machinery Co. 175 kw., 600 rpm., 2 phase, Allis-Chalmers. Both 2300 volt, 60 cycle, modern revolving field type. V. Nussbaum & Co., Fort Wayne, Ind.

60 CYCLE, 3 PHASE MOTORS FOR sale. 75 hp., 720 rpm., 440 volt, G. E. 100 hp., 720 rpm., 440 volt, G. E. 100 hp., 1120 rpm., 220 volt, Westinghouse. 200 hp., 600 rpm., 2200 volt, G. E. 250 hp., 580 rpm., 2200 volt, Westinghouse. This last motor is a Type "C" and will carry a 500 hp. continuous load. V. Nussbaum & Co., Fort Wayne, Ind.

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250 H.P. Slip-ring Motors, 600 R.P.M., 440 volts, 3 phase, 60 cycles. Two for immediate delivery.

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125 VOLTS DIRECT CONNECTED UNITS

350 Kw. Westinghouse Generator and Fleming Four Valve Engine.
250 Kw. Westinghouse Generator and Fleming Four Valve Engine.
50 Kw. Crocker-Wheeler. Ames Engine.
25 Kw. Westinghouse. Ames Engine.

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714 Van Buren St. CHICAGO

FOR SALE

On account of making room for turbine installation we offer the following machinery:

1—14x36 Heavy Duty Hamilton-Corliss Engine.

1—16x36 Heavy Duty Hamilton-Corliss Engine.

1—150 KVA. Belted, Type G. E., 2300 Volt, 600 RPM., 60 Cycle, 3 Phase Alternator.

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1 Direct Connected Engine Set, 17x21, 225 RPM., Erie City semi-Corliss Engine, direct connected to 185 KVA. G. E., 2300 Volt, 60 Cycle, 3 Phase Alternator.

All of the above apparatus is in good operating condition. For further information write the

WABASH VALLEY ELECTRIC COMPANY,
Clinton, Indiana.

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Large stock of new and used motors and generators.

REPAIRS

For any make, size or type.

SORGEL ELECTRIC CO.
MILWAUKEE, WIS.

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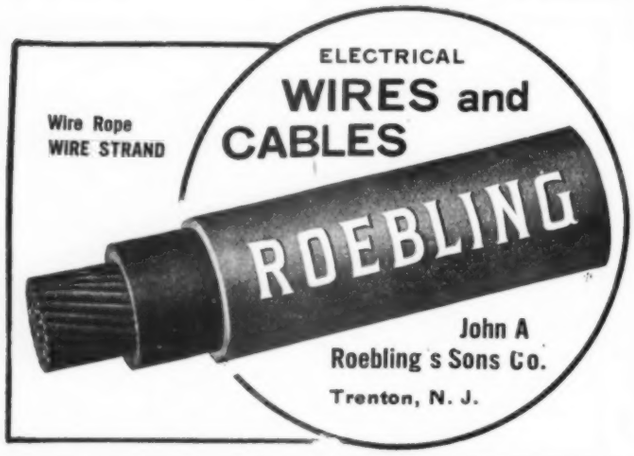

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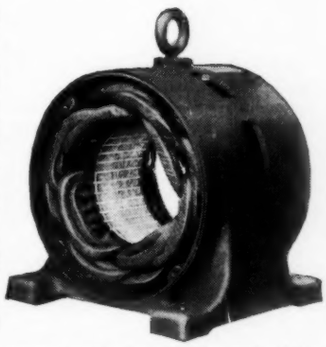

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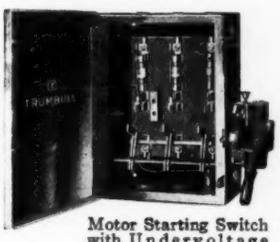
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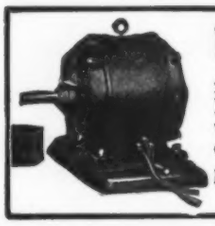

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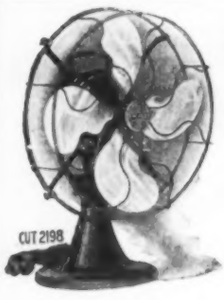

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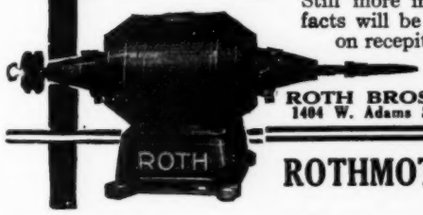

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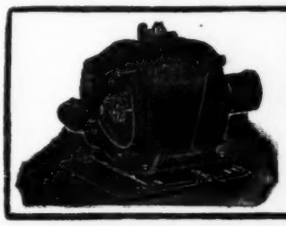

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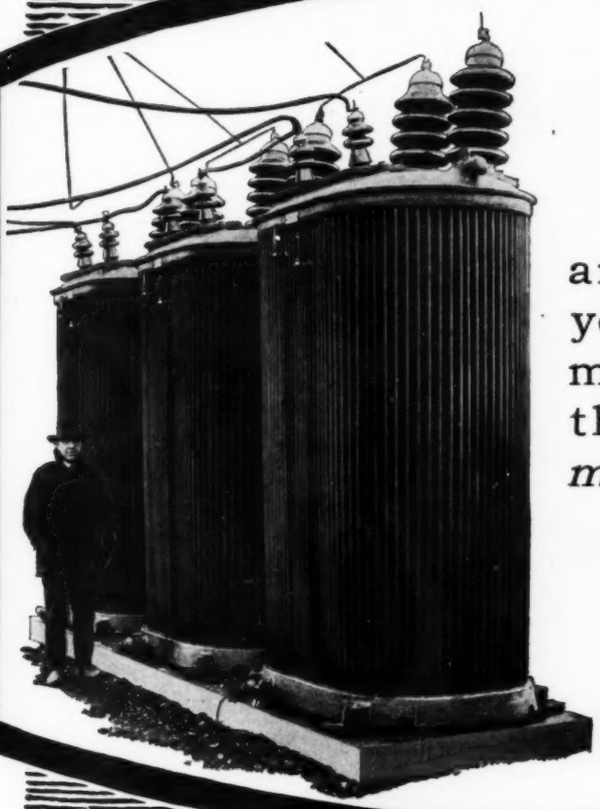

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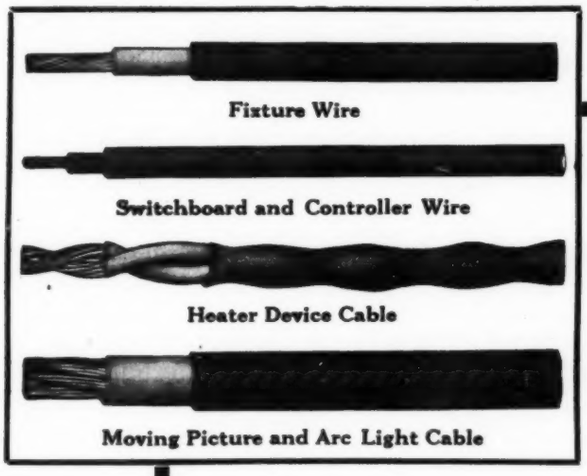

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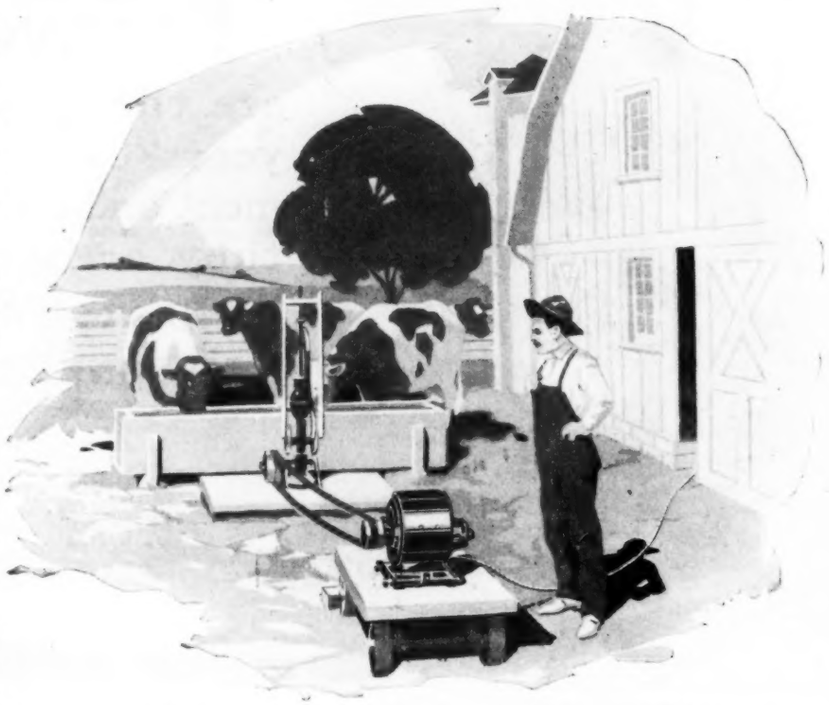

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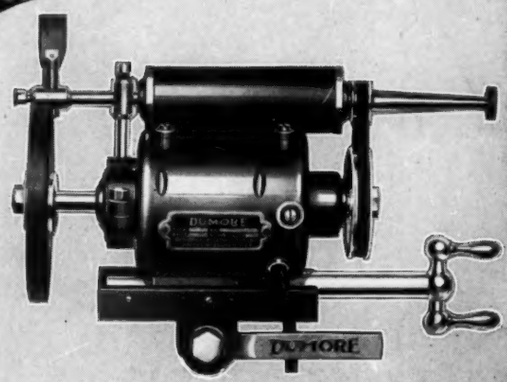

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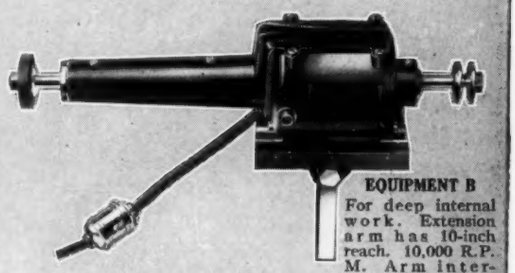

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